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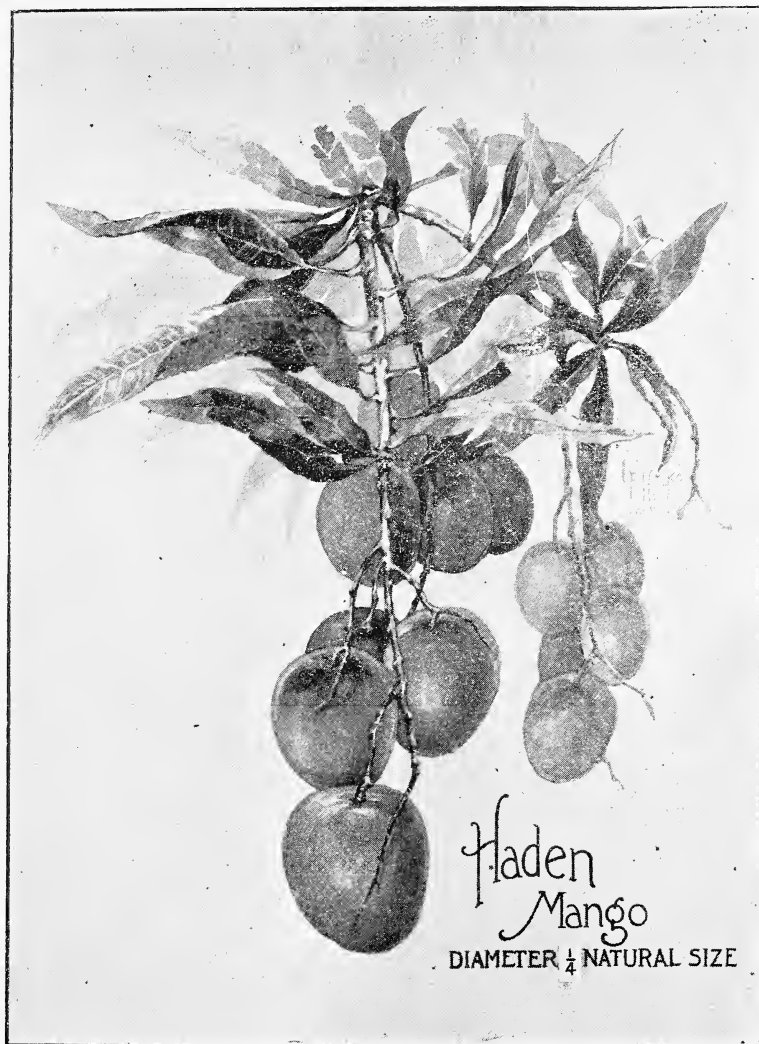
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U. S. Department of Agriculture

Tropical and Sub-Tropical

Fruits



Haden
Mango

DIAMETER $\frac{1}{4}$ NATURAL SIZE

FLORIDA NURSERIES, INC.

HARVEY BUILDING
WEST PALM BEACH

Compliments of the

Indian River Nurseries

West Palm Beach, Florida



MR. JOHN B. BEACH

"I started in the nursery business on the Indian River at Melbourne, in 1886 and moved to West Palm Beach in 1895. I have devoted all my time to the nursery business during that period."

JOHN B. BEACH.

PREFACE



FEELING confident that our many friends are interested in detailed knowledge of a number of tropical and sub-tropical fruits, we have assembled the information contained within these pages for your special edification and enjoyment.

The Florida Nurseries is a holding company, operating several nurseries of proven worth and long standing. One of these is the Indian River Nurseries, which was established in 1886 and founded by John B. Beach, pioneer and acknowledged authority in this specialized field.

We are greatly indebted to Mr. Beach for his help in assisting us in collecting the interesting facts printed in this booklet and we also desire to thank Mr. Wilson Popenoe, agricultural explorer, for it is he who has made it possible for us to print excerpts from his widely read book entitled "Manual of Tropical and Sub-Tropical Fruits."

C. H. HAMRE, President,
FLORIDA NURSERIES, Inc.,
West Palm Beach.

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West Palm Beach
Florida

SPECIALIZATION IN TROPICAL AND SUB-TROPICAL FRUITS

THE day of specialization is at hand and the man who centralizes his efforts on something that is in demand and which at the same time has little competition, is the man who will gain the greatest profit in life.

There are fruits that can be grown in practically every State in this Union, but the object of this booklet is to call attention to a few rare fruits that thrive ONLY in a tropical or sub-tropical climate, and as a consequence are most always at a premium on the retail markets.

We shall describe these fruits in keeping with their relative importance as regards the money-making opportunities now presented through their cultivation.

FLORIDA NURSERIES, Inc.

A Brief History of the Development of the Avocado

“IN all probability the Avocado was brought to Florida by the Spaniards, but the first introduction of which a record has been found was in 1833, when Henry Perrine sent trees from Mexico to his grant of land below Miami.”

North America horticulturists are accustomed to view the Avocado as one of the greatest undeveloped sources of food which the tropics offer at the present day. From their standpoint they are correct, but the inhabitants of Mexico and Central America would consider it more logical to assert that the Irish potato is a new crop deserving of extensive cultivation. North Americans view the Avocado as a possibility, but to the aboriginal inhabitants of tropical America it is a realized possibility.

“Four or five tortillas (corn cakes), an Avocado, and a cup of coffee—this is a good meal,” say the Indians of Guatemala.

It is precisely this condition—the importance of the Avocado as a food in these parts of tropical America where it has been grown since immemorial times—that has led students of this fruit in the United States to predict that Avocado culture will some day become more important than citrus culture in California and Florida.

To a certain extent, the Avocado takes the place of meat in the dietary of the Central Americans. It is appetizing, it is nourishing, it is cheap and it is available throughout most of the year. When these last two conditions have been reproduced in the United States, will not the Avocado become a staple article of diet with millions of people?

There is every reason to believe that eventually the Avocado will be as familiar to American housewives as the banana is today. The increasing scarcity of meat, and the fact that an acre of land will yield a larger amount of food when planted to avocados than it will in any **other tree crop** known at present, assures the future importance of the avocado industry in this country.

Quotation from
MANUAL OF TROPICAL AND SUB-TROPICAL FRUITS
WILSON POPENOE
Agricultural Explorer
U. S. Department of Agriculture



Twelve-Year-Old Trapp Avocado at West Palm Beach



This Photo was Taken from Above Tree. Fifty-nine Fruits on This Limb

ANALYSIS

The different varieties of avocado vary considerably in analysis. In the following comparative table of analyses of various foods the Avocado is credited with the maximum and minimum percentages found in the several varieties.

| | Water | Protein | Fats | Carbohydrate | Ash |
|---------------|------------|----------|------------|--------------|----------|
| Cream ----- | 74. | 2.5 | 16.5 | 4.5 | 0. |
| Avocado ----- | 60. to 80. | 2. to 4. | 15. to 30. | 4. to 8. | 1. to 2. |
| Eggs ----- | 73.7 | 14.8 | 10. | 0. | 1. |
| Salmon ----- | 64.6 | 21.2 | 12.8 | 0. | 1.4 |
| Guava ----- | 84. | .7 | .9 | 8. | .6 |

WILSON POPENOE:

The total dry matter in the edible portion of the Avocado is greater than in any other fresh fruit, the one nearest approaching it being the Banana, which contains about 25%; an average of twenty-eight analyses showed the Avocado to contain about 30%.

The percentage of carbohydrates is not high compared with that of many other fruits, because the Avocado contains almost no sugar.

The amount of mineral matter is much greater than is found in other fresh fruits. Soda, potash, magnesium and lime compose more than one-half the ash or mineral matter, which places the Avocado among the foods which yield an excess of the base-forming elements, as opposed to nuts, which furnish acid-forming elements in excess.

So far as protein and ash in fresh fruits are concerned, the Avocado stands at the head of the list, and with reference to the carbohydrates, contains on an average fully 50% as much as that found in many fresh fruits. These facts alone would warrant due consideration being given to the value of the Avocado as a fresh fruit. Its chief value as a food however, is due to its high content of fat.

Experiments have shown that the digestibility of avocado fat is equal to that of butter fat, and not below beef fat.

As to the caloric energy-producing value of the Avocado in twenty-eight varieties examined, one pound of the flesh represents an average of 1,000 calories. The maximum and minimum were 1,325 and 597 respectively. The maximum "corresponds to about 75% of the food value of the cereals and is so far from twice that noted for average lean meat."

In the following table the Avocado is compared in caloric value with several common foodstuffs. For this comparison a pound of Avocado flesh has been considered to represent 1,000 calories. This is not showing the Avocado at its best, for as just stated, in some varieties a pound represents over 1,300 calories.

| | Calories |
|--|----------|
| 100 Grams (about 3½ oz.) Boiled Rice ----- | 322 |
| 100 " White Bread ----- | 246 |
| 100 " Avocado ----- | 218 |
| 100 " Egg ----- | 166 |
| 100 " Lean Beef ----- | 100 |

The Avocado can be eaten by the most delicate person, and those who suffer from stomach or intestinal troubles find it the best food for their physical condition. When ripe, the fruit will fall from the tree, though still hard, but in two or three days it softens to the consistency of hard butter, when it is ready to eat. The meat is yellow inside, shading to green on the outside, and its flavor was aptly described by a farmer's wife from Illinois, who, on tasting her first fruit, remarked, "It is between a coconut and a muskmelon." It has a delicate, nutty flavor, very pleasing, and can be eaten plain with a little salt, as a vegetable, or with vinegar or lime juice or wine and sugar. Its favorite role is a basis for salad, in which position it stands in a class by itself. Nothing will take its place, as soon as it is once known. It is also excellent cut up in soup (at the table, not cooked).

Avocado Fat as a Food for Diabetics

(From Medical News Commercial)

Among the fruits that enter into the dietary of man, the Avocado, or Alligator Pear takes an almost unique place because of its richness in fat. A few fruits may furnish a noticeable quota of real nutriments in the form of starch and, particularly, sugars; thus an ordinary sized banana is rated at a food value of 100 calories or more. But for the most part the fruits that enter into the ordinary regiment, however palatable, wholesome and dietetically valuable they may be, can scarcely be rated as significant sources of energy. The part that they play in nutrition must be estimated from other standpoints. Accordingly, an edible fruit that may exhibit as much as twenty per cent. of fat* in its makeup is worthy of special consideration. It may prove, for example, to become a valued adjuvant to the dietary of the diabetic, from which the carbohydrate content of many common fruits unfortunately excludes them. The possibilities of the Avocado have been further promoted by recent investigations† in California and Washington, both of which agree in assigning an excellent utilization to Avocado fat, even when as much as 124 gm. (about 4½ ounces) a day were consumed. Heretofore, the market price of this fruit has prohibited a very widespread use of what now appears to be a nutritious as well as palatable food. The Avocado is indigenous to tropical and sub-tropical regions in the western hemisphere; but it is being cultivated to an increasing extent in Florida and California, and may ultimately become available at more reasonable prices in harmony with the history of some other tropical fruits. Dietotherapy will testify that the enrichment of the dietary with a really palatable source of fat will not be unwelcomed in the management of certain nutritive disorders. Ordinary cream rarely exceeds the Avocado in available fat content.

*Condit, I. J., and Juffa, M. E.: Bull. 254, California College Agr. Expt. Station, p. 381, 1915.

†Mattil: Ann. Rep. California Avocado Assn., 93, 1916. Holmes, A. D., and Deuel, H. J., Jr.; J. Biol. Chem. 41:227 (Feb.) 1920.



Soil Best Adapted to Avocado Culture

"In regard to soil, the Avocado is unusually adaptable, succeeding on sandy lands of Southern Florida.

"The heavy Florida soils seem to be much more favorable to the growth of the tree than light sands. A yellowish or brownish subsoil in many parts of Florida indicates good Avocado land. The Avocado prefers a moist, heavy loam and the closer this can be approached the better will be the results."

WILSON POPENOE.

WATER CONTROL

Avocados will grow on any soil where citrus growing is successful, but are more easily killed by lack of drainage and flooding. However, they do especially well on low land where the water table is not allowed to reach closer than 18 inches to the surface. They like plenty of vegetable matter in the soil and this should be supplied if the locality is deficient.

Land should be prepared same as for citrus grove.

In low land planting it is not a bad idea to supplement the drainage system by planting on mounds or ridges.

On high, sandy land the tree should be set down in a basin a foot or more below the surface, with the soil sloping down to it like a funnel, to collect and concentrate the rainfall while the tree is young. This will not be injurious to the tree in later years, as it would to a citrus tree when the depression is filled in with soil about the trunk.

IRRIGATION

"An abundance of water is especially important during the first two or three years after the tree is planted, if rapid, healthy growth is to be maintained.

"One of the most experienced growers, near Miami, states that trees which have had abundant irrigation are as large at four years of age as non-irrigated trees at six years. Their larger size enables them to yield commercial crops earlier than non-irrigated trees.

"Several crop failures have been blamed on unusually dry weather during the period the fruit is setting.

"A drought probably does little harm if it occurs when the trees are just beginning to bloom, but if it continues, the flowers are likely to drop and the crop be a failure. This has been the experience with Trapps when grown on deep sand; on heavy soils, which are more retentive of moisture, the danger is less.

"The grower should certainly be prepared to irrigate at the time the fruit is setting. In southern Florida, this is usually in March and April.

"In Florida few crops are irrigated, and up to the present it has been the general custom not to irrigate avocado trees except during the first two or three summers. It is coming to be recognized, however, that a wet spring is followed by a good avocado crop (a condition exactly reversed with the Mango). As a result of this observation, irrigation is beginning to be practiced in Southern Florida, especially in seasons when the rainfall is below normal.

"The necessary soil moisture can be supplied easily and satisfactorily, but the relative humidity of the atmosphere cannot be altered artificially; hence in regions where the humidity is exceedingly low the Avocado suffers in the dry portion of the year. In Florida, no attention need be paid to this subject, since the humidity closely approaches that of the West Indies and other regions where the Avocado is at home."

WILSON POPENOE.

PREPARATION OF SOIL

In preparing the soil to plant avocado trees, the "advice to growers" just preceding, will apply in a general way. But avocados will stand forcing in a way which would prove disastrous to citrus trees or mangos, and to secure the full benefit of the vigor and push of the seed-grafted trees, special preparation of the hole is desirable. Horse manure is one of the best fertilizers for avocados, though for that matter, the manure of cows, hogs, chickens, sheep or goats is excellent. One of my customers wrote me that he had some of my seed-grafted trees planted in May, 1919, which in May, 1920, were 10½ feet high, with spread of branches to correspond, having bloomed the preceding winter, but not allowed to hold any fruit. All this was on pine land. I asked him how he obtained such surprising results in so short a time, for this was even better than would be looked for on custard-apple hammock, and he gave me the following explanation: He had used one-half a single wagon load of horse manure, one bucket each of raw bone, tankage and goat manure, spaded deeply into the soil and allowed two or three months to rot and mellow. He mulched with plenty of tobacco stems, and was careful that the trees were never allowed to lack abundant moisture. He said he was unable to attain such results with ordinary budded trees, as they would not respond sufficiently to such treatment, and he implied that he could not secure such amazing results with less generous use of fertilizers. Trees in custard-apple land, abundantly supplied with moisture the first year will closely approach such growth but abundant watering is required during the period, to produce maximum results. Contrary to the rule with citrus trees and mangos, there is no danger of die-back from forcing the growth. The faster you push them the better they will succeed in the long run. Plant same distance as citrus trees.

In planting, first remove the bottom of the box and then, after placing the tree in the hole, pack the soil lightly around the box; then split each

side with a sharp hatchet and lift them out carefully so as not to disturb the roots; then pack soil firmly and water well. This lessens danger of attack from woodlice. Keep well watered during the first year, and after that trees will take care of themselves. Culture is the same as for citrus trees. When planted you should mulch with plenty of tobacco stems. This is to keep off woodlice and to supply the needed potash. Bear in mind that the trees must be kept properly moist during the first year, while their roots are getting spread in the soil, and on high land in dry weather in summer, three buckets per week is often required. No expensive irrigating plant is needed, as a mule and wagon will answer, and can be easily moved elsewhere after the first year, when it is no longer needed. A good plan is to drive four plastering lath about a foot in the ground around the tree in the shape of a rectangle, four feet deep east and west and two feet north and south. Nail two lath and three half lath between the tops and stretch a strip of burlap, old grain or fertilizer sacking on top and tack it firmly. This will furnish a partial shade from 9 A. M. to 3 P. M. This is not essential, but saves moisture, prevents sunburn and is a decided aid to the young tree.

FERTILIZER

"As materials from which fertilizers suitable for Avocados may be compounded, cotton seed meal, castor pomace, tankage, ground tobacco stems and ground bone are to be recommended, with a certain amount of nitrate of soda used as a source of nitrogen when quick results are sought as in the care of trees which have 'started back'.

"A formula that has given good results is built up of cotton seed meal, castor pomace, tankage and ground tobacco stems, analyzing 4% to 5% ammonia, 6% to 7% phosphoric acid and 2% potash.

"The trees were usually cultivated by hoeing three times each year and a heavy mulching of dead grass or weeds during the dry winter season. If, instead of dead grass, a mulching of compost or well rotted stable manure is used, the results are even more satisfactory and the February application of fertilizer may then be omitted entirely."

W. J. KROME.

TILLAGE—MULCHING—COVER CROPS

"The ground around the young trees should be kept liberally mulched with weeds, straw, barnyard litter, seaweed, or any other coarse material which is not injurious and will not pack and form a layer impervious to air and water.

"Deep cultivation must be practiced with caution.

"On shallow soils the most healthy and vigorous trees are those which are mulched. The mulch should extend at least two feet in each direction from the trunk of the young tree, and as the latter increased in size and

its roots reach out on all sides, the mulch must be enlarged to be always a little wider than the diameter of the crown.

"Mulching serves two purposes: It prevents the soil from drying out rapidly and it protects the delicate feeding roots from injury due to excessive heating of the soil.

"When the trees are of mature size, the shade furnished by their own foliage, together with the fallen leaves which carpet the ground, aids materially in maintaining the soil in good condition; but additional loose material, especially during the summer, is highly desirable.

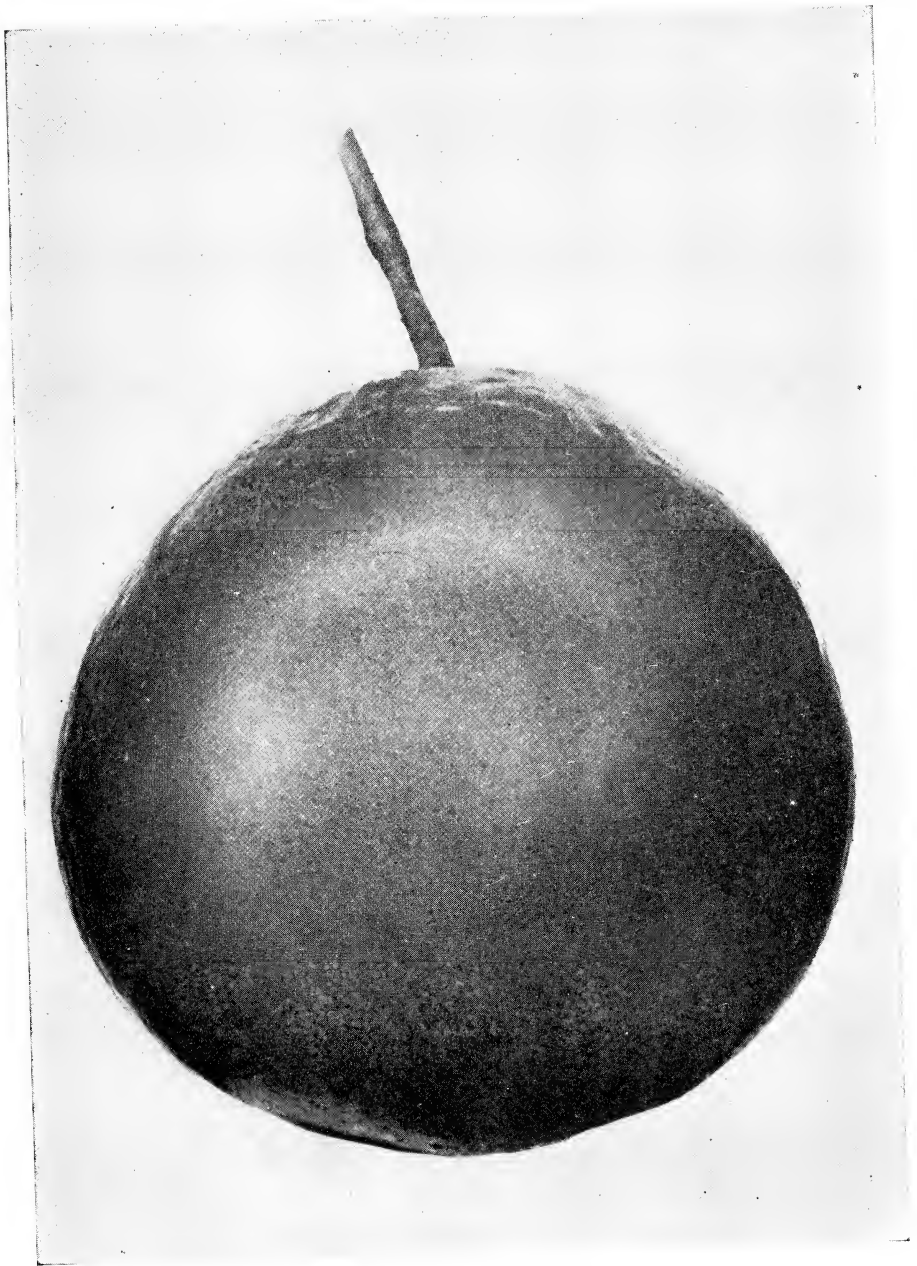
"The use of green cover crops between the rows is decidedly beneficial, but they must not be brought close enough to the trees to rob them of their food. Cowpeas and velvet beans have been used for this purpose." (Crotalaria is highly recommended.) "A clump of pigeon peas (*Cojanus Indicus*) planted four feet to the south of each young tree will provide shade during the first summer or two, serve as a protection from wind and aid in enriching the soil."

W. J. KROME.

In May, 1914, some new settlers near here planted groves on spruce-pine land. All planted some of my seed-grafted trees, and received in substance the foregoing advice from me. Being new to Florida, they had no preconceived ideas of their own on the subject, and followed my advice pretty closely. When planted, these trees were about 16 or 18 inches tall and were seed planted in September, 1913, and grafted the following November. June, 1915, I visited the groves and found the trees standing from four to five feet high, with a spread of three to four feet, and nearly one-third of them holding fruit, some as many as 20. Now I do not advise allowing a tree to hold more than one or two at most the first year, and believe it better to pick them all off the first two years, as a maturing crop so young generally stunts and injures the tree. But I had a tree of the Family variety which, planted out in November, matured 23 fruit the second July, and it did not injure the tree except to cause it to lose about a year's growth.

All growers should bear in mind that the future of the grove depends mainly on the CARE GIVEN IT THE FIRST YEAR. Do not fail to give trees PLENTY OF WATER, and spray with copper solution AS OFTEN AS NECESSARY. With good attention the first year, the grove will stand much neglect thereafter, and suffer less harm than a citrus grove would, under similar circumstances.

The culture of an Avocado grove is practically the same as a citrus grove with the following exception: Avocados do not require the same amount of spraying. The reduced cost of spraying will about make up for the increased amount of fertilizer required. The market price for Avocados will average about three times as much per box as that of citrus fruit.



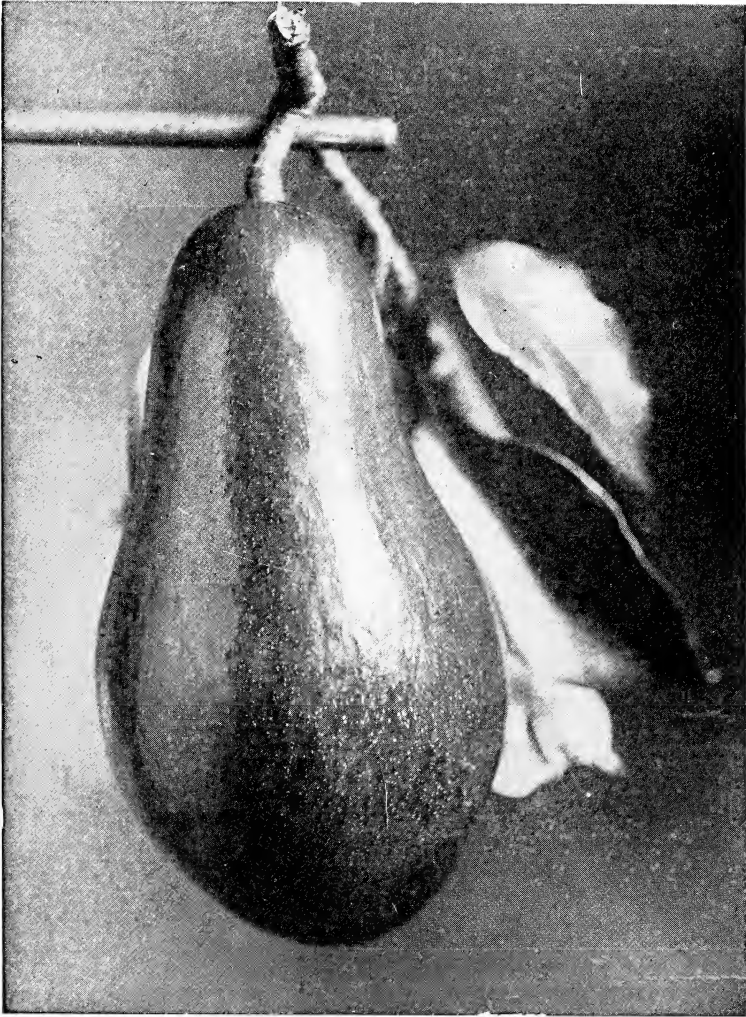
Trapp Avocado. Two-thirds Natural Size

ENEMIES

In some localities young trees are quite subject to attack of fungus which makes black spots on the leaves, and often girdles the stem, sometimes killing the tree. To prevent this it is well to spray some fungicide, monthly and in wet weather. Following will prove convenient and efficacious: Dissolve 8 pounds bluestone in a 50-gallon barrel or water, and 10 pounds of sal soda (sodium carbonate) in another 50 gallons; keep covered to prevent evaporation, and mix in equal parts as needed. Apply the same day it is mixed. In this way you may have your solution fresh whenever you want it, and as long as kept separate they will keep for years. An excellent precaution, where this trouble is feared, is to paint the trunk of each tree with whitewash made by using some of the copper solution above, thickened with air-slacked lime, before planting. The Avocado is sometimes troubled with scales, and the guava fly has been known to attack it. Usually the tree drops its leaves, and that puts an end to the trouble, new foliage coming out clean of insects. This fly closely resembles the whitefly, but it never attacks citrus trees—the wild pawpaw being its chief food. It does little harm to the Avocado.

A full list and description of the various insects affecting the Avocado can be obtained through the U. S. Department of Agriculture by applying for a copy of the bulletin, "Its Insect Enemies and How to Combat Them."

On the whole, the Avocado has not one-fourth the enemies that the grapefruit has in Florida, and the fruit brings over twice as much in the market. Any good scale destroyer may be used for the guava fly, or any scale which may chance to attack the trees. But the best plan is to feed your trees well, and if given a proper start the first year, by supplying sufficient moisture, the chances are that neither scale nor fungus will trouble them again. Bear in mind that the Avocado is a gross feeder and can make good use of about twice as much fertilizer as citrus trees of same age. While they live and thrive on less, they will repay you many-fold for the extra food in growth and fruit. A good plan is to give them the same commercial fertilizer you would your citrus trees, and in addition, an equal value of manure, castor pomace, tankage or other form of organic nitrogen.



Family Avocado



Seven-Year-Old Family Avocado at West Palm Beach

Avocado Culture in Florida

PLANTING

In places where yellow subsoil appears at a depth of one to four feet a good plan is to dig down to this and fill up with yellow soil all the way. Where compost is not available, a little bone meal mixed thoroughly with soil and allowed a few weeks to decay, answers very well with the tobacco mulch to complete the fertilizer.

I advocate close planting for avocados for the following reasons: The trees protect each other from wind and cold and the two classes being closer in contact the cross-pollination is more readily accomplished. The trees may be planted closely in the row alternating the classes (say 15 feet) and the rows may be spaced farther apart (20 to 35 feet) according to the ideas and convenience of the grower, providing space for cropping in between the rows. My preference is 15x25.

FLATWOODS PLANTING

In flatwoods, it is always advisable to bury one-fourth pound of dynamite $2\frac{1}{2}$ to 4 feet below the surface where the tree hole is to be made, and explode after thorough tamping. It is of great value even where there is no hardpan or rock, as trees planted after this preparation, even in sandy spots, show a great gain over those on similar land not thus prepared. It may be due to the nitric fumes of the nitroglycerine, which are driven deep into the soil by the explosion. Also dig out a hole 18 inches deep, and in planting fill with top soil, scraped from the surface, which is always mellower. If you are sure of ample drainage, mounding is not advisable, otherwise it is a wise precaution.

PRUNING

Most varieties of avocados require but little pruning is properly headed at planting time. Later pruning will consist largely in removing weak or undesirable growth. A few varieties tend to grow straggly, with long unbranched limbs, and these need considerable pruning and heading back to train them to the desired low-headed, spreading, symmetrical shape.

Where trees show a tendency to grow tall, topping is sometimes necessary.

The Family tree pictured on page 16 has been topped by myself three times at intervals of five years. This tree, by the way, seems to be an exception to the self-pollination discovery made by the agricultural department. It is isolated from the nearest avocado tree by a two and a half story building and we have no bees, nevertheless it has not failed to mature a full crop every year for the past twenty years. This is in spite of the fact that in the storm of July, 1926, it was blown flat on the ground.

FROST PROTECTION

Avocado growing in Florida stands in the same relation to the climate of this state as the citrus culture in California does to the climate of that

state. Los Angeles is north of Charleston, South Carolina, in latitude, and the mean temperature is therefore considerably lower than that of Florida. The entire citrus industry of California absolutely depends upon artificial heating. In Florida, we can protect our avocados in the same way they do their citrus, when necessary—although in 20 years we have never found this necessary at Palm Beach. Certain localities have better natural protection than others, but the coldest spots in Florida can safely grow avocados by selecting the hardiest varieties, and giving artificial protection. In this section (Palm Beach), avocados of the most tender class have never been injured since 1905, and this without any artificial protection.

Where light frosts may be looked for, the following is a suggestion which may or may not prove of value. All avocados and mangos while young are subject to injury from light frosts. While small, a cabbage hamper or barrel may be placed beside each tree, and used to cover it when frost is threatened. The second year the trunk and larger limbs may be wrapped with newspaper, as an additional safeguard to the banking with sand, which is generally relied upon.

While trees are young, they are severely injured or even killed by cold, which would not hurt them after they had grown to a considerable size, and an excellent policy, which is really only an economical insurance, is to provide sufficient orchard heaters, to be fired when a cold warning is sent out, and protect your young trees from any danger. To aid in utilizing this insurance, it is a good plan to plant some winter truck crop among the newly set grove, which will in no way interfere with the vigor of the trees, and share the protection afforded by the heaters. Or bananas or pineapples may be thus utilized to good advantage. By applying sufficient fertilizer for both, the land may be cropped till the trees crowd out the field crop, with actual benefit to the orchard. The ground is shaded by the crop, and humus supplied.

Avocado growing in Florida is still in its infancy, but we already know that different varieties prove best in different localities. Each grower should plant a number of the most promising sorts, as he cannot tell till he tries just which is going to best suit his local conditions.

Certain races of avocados will stand more cold than others. We have classified these in the catalogue with this in mind, so as to furnish trees adapted to different sections of the state.

The principal mistake has been the lack of knowledge of the peculiarity of Class A and Class B.

Another mistake has been the planting of tender varieties in sections too cold for them.

They ship as well as citrus.

(Reference: U. S. Bulletin No. 387.)

Avocados, like most all fruits, are NOT GROWN FROM SEED. In order to get THE TRUE VARIETIES, this must be accomplished by grafting or budding.

The great thing about Avocado trees is, if possible, to plant the seed where you want the tree to grow, and never disturb it, as all the old settlers know. In 1908 I developed an improved method of propagating my Avocados. I insert a graft as soon as the seed sprouts so that the entire growth of the sprouting seed is made in the graft.

This system has been developed and improved from time to time since, and a modification of it has been adopted by Wilson Popenoe, agricultural expert of the United Fruit Company, of Honduras. Mr. Popenoe's father, a pioneer Avocado grower in California, has found the air in California too dry for the successful use of this method. As a consequence they must follow the old method of shield budding there.

By my method of grafting as soon as the first sprout leaves the seed, the first leaf made is from the graft, and as the seed is in a box, every rootlet it makes is undisturbed when you plant it out in the grove. By the time the top has attained the standard size (15 to 25 inches), the roots will have filled the box and the tree must be set in the grove at once to obtain maximum results.

SELECTION OF STOCK

It is impossible to tell from the size of the seed what sort of tree it will produce. Large seeds often make weak trees with poor root systems, while a very small one will often make the most sturdy and vigorous one. Seed as soon as sprouted are dug up and inspected, and numbers discarded owing to imperfect root system, weak sprout growth, or some other defect, so that only the most vigorous are retained for stock to propagate. At this time the seed pass two inspections and from 65% to 70% are rejected and thrown away. This has a great deal to do with the remarkable vigor and prolificness of "seed-grafted" trees. They will often bear the second year, but it is best not to allow them to mature a crop before the third year, when, if well grown, they should yield a box per tree.

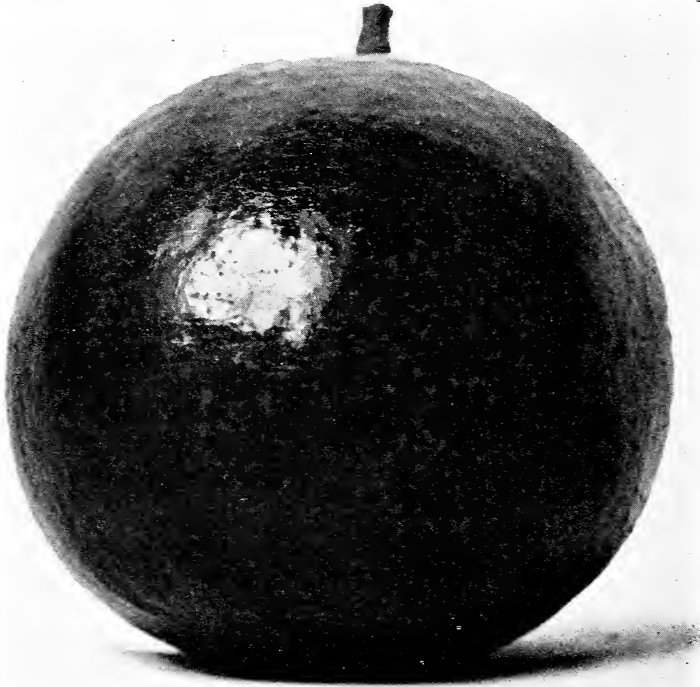
Being box-grown, avocados may be transplanted any time of year, yet for various reasons which I will not mention here, trees set from April to October succeed better than trees set from October to April.

EXPERIMENTATION

The Agricultural Department has been investigating the cause of the uncertainty of the setting of the Avocado. They have recently discovered that all avocado trees are divided into two classes.

In Class A the pistils are receptive in the morning; then the flowers close for a short time at noon and when they open again the pistils are no longer receptive of pollen and the anthers have opened for the first time that day and the pollen is exposed.

In the other, Class B, the situation is the reverse, so that under ordinary circumstances no one tree can pollinize itself, but must have assistance from the opposite class.



Winslowson Avocado—About Half Natural Size

They have also found that the pollen is heavy and sticky and generally must have the agency of insects to distribute it. Hence it is a good plan to have bees in an orchard and the two classes must be planted side by side to assist in mutual pollination.

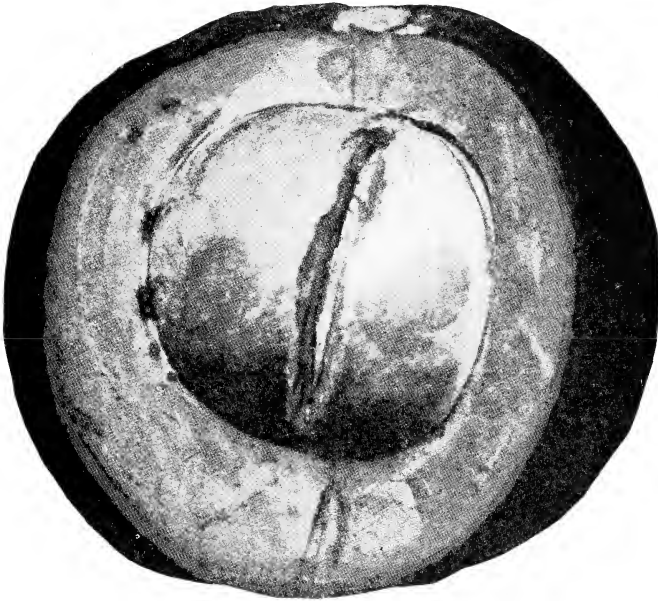
"Class A, having only first-period flowers (receptive) in the forenoon; second-period flowers shedding pollen in the afternoon. Class B having only second-period flowers, shedding pollen in the forenoon; first-period flowers (receptive) in the afternoon. This classification may be altered or upset by sudden and violent weather changes but holds good for weather favorable to pollination and fruit setting."

T. RALPH ROBINSON, Physiologist.

In the light of recent discovery about cross pollination, we are propagating a limited number of trees with a graft of each class (A-B) on each tree to further this mutual pollination.

Where a person has only room for a single tree, this will obviate the necessity of planting two.

Windbreaks are even more important for avocados than for citrus groves (as the wood is brittle) and should be planted immediately when



Winslow Avocado—Natural Size

the grove is set, if the natural windbreak is not already present. We recommend the Casuarina (or so-called Australian pine).

TYPES

Avocados may be divided into three types, which differ almost as much from each other as do the various branches of the citrus family, as orange, lemon and grapefruit, both in habit, foliage, fruit, odor of foliage and cold-resisting power.

CLASS 1—WEST INDIAN TYPE (For South Florida)

This is the most tropical and bears the largest fruit, and is, in fact, the only type known in the markets of the East. Practically all the trees bearing in Florida and the West Indies are of this type.

TRAPP (B).—Matures so it may be eaten about November 1st, but hangs on the tree so the main crop is marketed in December, when prices are high.

Nearly round in shape, of excellent quality and flavor, exceptionally good shipper and keeper, bearing young, and enormously productive, this is a variety for general commercial planting. It has stood the test of over 20 years, and established a name in the markets of this country like the Sicily lemon and Havana cigar, and needs no advertising to introduce it.

FAMILY (A).—See cut on page fifteen.) Matures fruit during July and August, lasting well into September. Seed small. Fruit pear-shape. Color green, changing to purple when ripe; flavor very delicate. Specially recommended for home use. Weigh $1\frac{1}{4}$ to $2\frac{1}{4}$ pounds.

POLLOCK (B).—Ripens in August and September. Weight, 2 to 4 pounds, sometimes 5 pounds; seed small; color green; pear-shaped, with a thick neck; flavor very rich and nutty. Not so rich as Gottfried.

BEACH'S CHOICE.—Pear-shaped, green fruit, ripening in September and October. Very superior quality. Weight 1 to 2 pounds.

WALDIN (A).—Not so round as Trapp. Seed a trifle smaller, and season a trifle later. Highly prized about Homestead.

The six following are natural hybrids, produced by accidental pollination of Florida Guatemalan type seedlings by West Indian type pollen (probably Trapp) through the agency of insects.

WINSLOWSON (B).—(Syn., Nameless, Rolfs No. 50 and No. 133.) Seedling from Winslow, which appears to have been hybridized with a West Indian, as it more resembles Trapp than it does Winslow. Larger than Trapp (30 to 40 ounces), rounder in shape, darker green and glossier, seed relatively smaller and always tight-fitting. Season same or perhaps a trifle later. Prolific and precocious bearer. Much more vigorous and wonderfully resistant to insects and disease. It should be planted in localities where Trapp has proved a failure. From its parentage it is likely to be more cold resistant than Trapp.

COLLINSON (A).—Seedling from Collins, is a very promising fruit. In size it much resembles Trapp, which variety is probably its male parent, but its season is that of the female parent—January and February. Has not fruited as long as Winslowson, not as large, but richer.

COLLINRED (A).—This is almost identical with the above except that the color is red.

TAYLORSON.—Seedlings of Taylor. Pear-shape green fruit. Weight $1\frac{1}{4}$ to 2 pounds. Ripens in January.

PINNELLI (or Christmas Grand). (A)—This is deemed to be a natural hybrid between the Pollock and a Guatemalan seedling. The fruit closely resembles that of the Pollock in size, appearance and quality, but its time of maturity is several months later, much of the fruit usually holding on till Christmas.

FUCH'S EARLY.—A new variety, not yet classified with regard to pollination. Ripens in June.

CLASS 2—GUATEMALAN TYPE (For Middle Florida)

The Guatemalan type originates in the elevated table lands of Guatemala, where considerable cold is experienced in winter, and is accustomed to endure almost as much as the orange. Fruit has a rough, thick rind, almost a shell in some varieties, and a tight seed. The first, while

it injures the appearance, improves the shipping and keeping qualities and, like the russet orange rind, may be a blessing in disguise. The tight seed also adds to shipping value. The fruit is generally smaller than Class 1, not so rich in coloring of meat, and a trifle different in flavor.

This type is comparatively new in Florida and still in the experimental stage. Trees which thrive in California often act differently in Florida, and trees brought from the table lands of Guatemala from altitudes of 3,000 to 6,000 feet, would naturally be expected to meet quite a shock when removed to sea level in Florida. Many highly recommended and promising varieties elsewhere I am impelled to discard annually after a few years trial, having developed some undesirable features.

WINSLOW.—This is probably the best of the spring avocados of Guatemala, hard shell type, among those of the Florida origin. May be eaten as early as March, but does not begin to drop until April, and some hang on into August. Thus the crop may be marketed any time in March and April, without waste, or held later and used as they drop. A seedling from Guatemala seed, which has fruited six years in Florida and proven a vigorous grower and good producer. Flavor very rich and nutty, smooth and delicious. Superior to any West Indian fruit.

Tight seed, and thick, hard rind make it an ideal shipper, as well as its shape, which is almost globular. Color, dark green. In spite of the fact that the fruit does not mature till after the following crop is set, my old trees have held and are maturing a maximum crop every year in spite of the handicap of a heavy pruning for buds and grafts. Weight 8 to 12 ounces. (See cut on page 21.)

WAGNER (A).—Promising variety, highly prized at Homestead. Skin very rough and knotty. Color green. Weight 12 to 16 ounces. Almost round in shape and very prolific. Quality good. Splendid shipper. February and March.

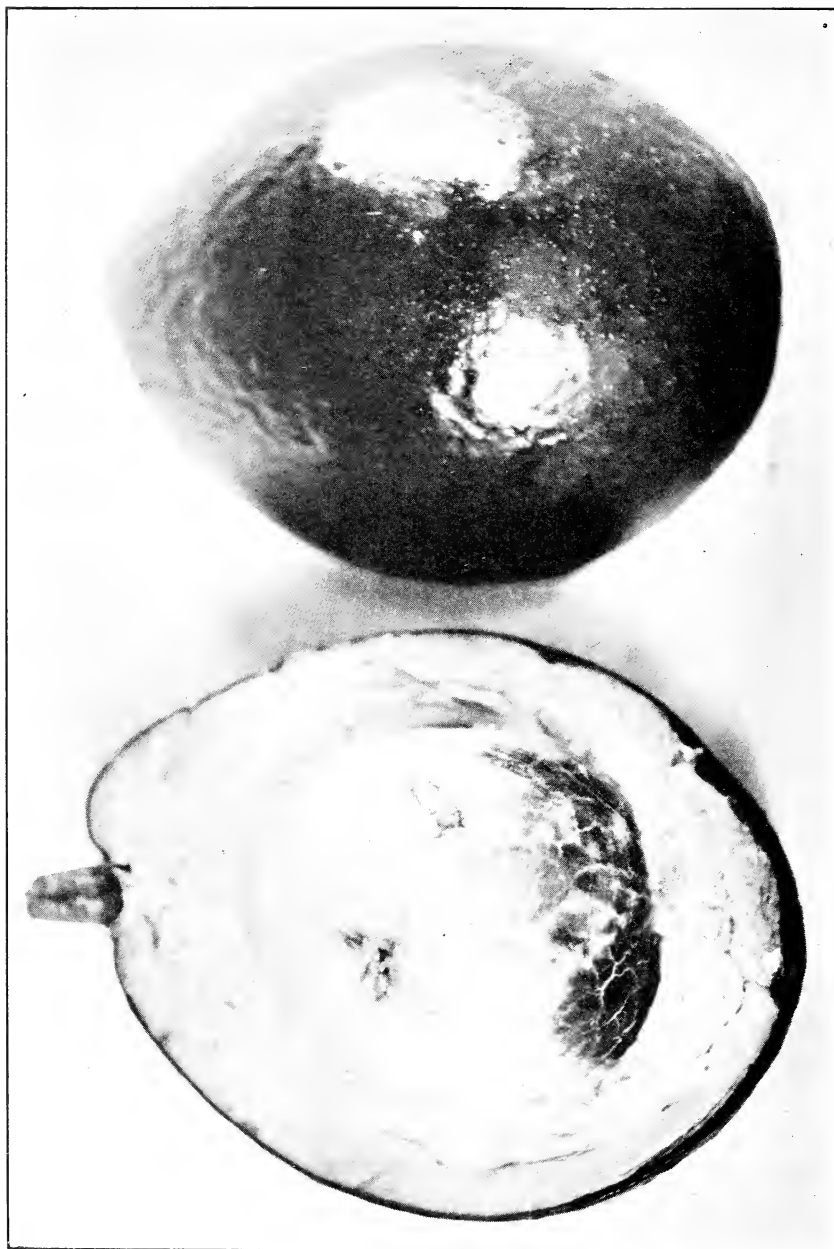
✓ **SCHMIDT (B).**—Color green. Quality excellent. Season March and April. Weight 1 to 2 pounds.

LULA (B).—Color green. Weight about one pound. Quality very good. Flesh straw colored. Vigorous grower and very productive. Season November, December and January. This variety proved as hardy as Class 3 during the freezes of 1917 and 1918.

This is said to be a hybrid between the Guatemalan and Mexican, like the Fuerte.

LINDA (B).—Very large, dark purple fruit, 30 to 50 ounces in weight. Regular bearer. Shape oval. Flesh pale yellow, rich and smooth. Seed very small. Extra long keeper. Reported from California as the best keeper known. Quality and flavor unsurpassed. January and February.

EAGLE ROCK (B).—Large green fruit, ripening in March. Seed small. Quality fair. Some fibre. Prolific. Weight 2 to 3 pounds.



Pueblo Avocado—Natural Size

CLASS 3—MEXICAN TYPE (For Northern Florida)

In the lofty table lands of Mexico a still hardier type is found, which has to withstand freezing temperatures frequently, with ice and snow. The fruit runs still smaller than Class 2, but is generally richer in fat than either of the other types. The skin is generally thinner, with adhering pulp, but smooth and with a tight seed.

Trees of this type have been bearing regular crops in Alachua County for the past 30 years, and now stand 40 feet high, being undamaged when oranges beside them have been frozen to the ground. Also spring frosts which destroy the peach and Leconte pear blossoms in the same grove, have never shortened the crop. This type possesses the odor of anise in its foliage, as a distinguishing characteristic, instead of the sweet bay odor of Class 2.

FUERTE (B).—Weight twelve to sixteen ounces. Fat 30.72%. Pear-shaped. Color green. Skin thin but hard. Flesh straw-colored, smooth, rich and well flavored. Unusually vigorous grower and good producer. It is about the richest known avocado and runs higher in fat than does the olive in California. Matures in December and January and is almost as hardy as the pure Mexican, though probably a cross of Mexican and Guatemalan. Foliage has characteristic anise odor.

GOTTFRIED.—This remarkable tree is pure Mexican, and hence extremely hardy; adapted to the colder portions of Florida. Mexican fruit is generally very small, but this is certainly an exception. Average weight about a pound; color purplish-black when ripe; quality unsurpassed, as rich as a nut, and ripens in August and September. I can recommend this highly for commercial planting on a large scale in middle and northern Florida. No Cuban fruit can compete with it in richness and quality and nobody would buy them as long as Gottfrieds were to be had. Unlike other Mexicans, it peels readily and its meat is rich yellow with no objectionable twang nor fibre.

SAN SEBASTIAN (B).—Skin glossy black, separating readily from the rich golden yellow flesh. Season June. Weight 6 to 8 ounces.

Many varieties of classes 2 and 3 which have been very successful in California have, after eight to ten years test here, proven such shy bearers that I have ceased to propagate them.

HARVESTING AND MARKETING

By T. Ralph Robinson, Physiologist

“The main harvest season extends from July to December, but when the very late Guatemalan varieties now being planted come into bearing, the Florida avocado season will extend through most of the year. The fruit is picked when full grown and mature, but before it begins to soften on the tree. It is then carefully graded and sized. The soft and imperfect

fruit is discarded or used locally, and only the firm, sound fruit shipped. Great care is taken in all these operations not to bruise or puncture the fruit, as it has been found that such injuries are the cause of most of the decay in transit to market. When carefully picked, graded, packed and promptly shipped, avocados carry in excellent condition from Florida to the most distant markets in the United States.

"By using printed wrappers, customers should be instructed in the use of avocados, and especially warned not to eat or serve the fruit until it is soft (not mushy) throughout. The attempt to eat an unripe avocado is not only disappointing but may be so distressing as to discourage any further purchases of this excellent fruit. The grower or shipper should market only fully developed fruit in proper condition to complete the ripening process. The attempt to salvage windfalls and premature crops will only lead to disaster, both for grower and consumer.

"The standard package for avocados in Florida is the tomato crate. Some growers wrap fruit in tissue paper, and nearly all use cushions of excelsior between the fruit to prevent bruising. For the fancy trade, from two to four dozen fruits are packed to the crate. For the long distance shipment in warm weather, a special crate with a center compartment to hold ice is used with satisfactory results.

"Cold storage for periods of a month to six weeks is possible with some varieties, as Trapp and Waldin, but the practice has not been developed in any large commercial way. It is usually adopted to meet some special demand."

T. RALPH ROBINSON.

CROPS, PRICES AND PROFITS

Some varieties, including Trapp, tend to bear when very young and need careful thinning to prevent weakening the trees. No fruit should be allowed to mature the first year, nor during the second year, unless the tree are making a very vigorous growth. In the third season, twenty or thirty fruits may be left to ripen on thrifty trees.

The yield of mature trees varies so greatly, depending on the variety, season and skill used in caring for the grove, that no satisfactory yield averages can be given. Large seedling trees favorably located sometimes ripen several thousands of fruits in a single season, but such yields must not be taken as an average to be expected in commercial plantings. Some of the best cared for Florida groves average three, five or even more crates to the tree annually, but the average for all groves, owing to the selection of unfavorable sites, or unprolific varieties, or to unskillful management and neglect, is very low. Many groves have been unprofitable, although the market demand for avocados is excellent and high prices have been received and good profits made by all growers who have secured good crops.

Prices netted by growers during the past five years have ranged from five to ten cents per fruit in midsummer to fifty cents, or even more, in the very late fall and winter months.

Mr. L. P. Kirkland, of Lake Alfred, Florida, sold sixty boxes of Avocados, Lulu brand, last November (1927) for \$30.00 per box. There are about the same number of Avocados in a box as grapefruit.

There is little doubt that the Avocado will eventually become an important and profitable crop in portions of Florida. Much still remains, however, to be learned about cultural methods and varieties, and until the industry has passed the experimental stage the prospective investor should proceed with caution. A thorough personal investigation of the groves in Dade County, and other localities where there are plantings, will be an invaluable aid in planning a grove.

For the home fruit garden the Avocado is well adapted. Small variety collections should be planted out in protected localities in Florida with a view to having this valuable food available through a good part of the year. With the rapidly increasing population, especially in the winter, the local markets may well be as profitable as the distant centers of consumption.

Publications relating to the Avocado, listed below, should be consulted for more detailed information on pest control, and composition of fruit.

The Avocado: Its Insect Enemies and How to Combat Them. U. S. Department of Agriculture. Farmer's Bulletin 1261 (free).

Red Spider on the Avocados: U. S. Department of Agriculture Bulletin 1035 (10 cents).

Some Changes in Composition of California Avocados During Growth: U. S. Department of Agriculture Bulletin 1073 (5 cents).

Avocado Diseases: Bulletin No. 161 of the Florida Agricultural Experiment Station. Gainesville, Florida.





The Mango

The Mango is the king of tropical fruits, standing at the head in size of tree, appearance and quality of fruit.

The improved varieties may be described as a combination of peach and pineapple, with a richness and substance not found in any other fruit in the world. The aroma of ripe mangos is most enticing and will fill a room with fragrance like a bouquet of flowers. The coloring of some varieties is gorgeous and as gay as the tropical parrots—carmine, orange, green and yellow combining to make them attractive. They are excellent shippers, and can be sent by parcel post all over the United States successfully in the hot weather (of course without refrigeration). With proper refrigeration they have been shipped for many years past from Bombay to London.

The Mango will thrive on a greater variety of soil than any other fruit tree that I know of. It will produce excellent fruit on the poorest, driest sand ridge, and it will thrive in a low mangrove swamp too wet for any ordinary tree. It will grow in rocky soil, but prefers a deep soil and good drainage.

THE HISTORY

“Akbar, the Mughal emperor who reigned in northern India from 1556 to 1605, planted near Darbhanga the Lakh Bagh, an orchard of a hundred thousand mango trees. Nothing, perhaps, more eloquently attests the importance of this fruit and the esteem in which it has long been held than this immense planting, made at a time when large orchards of fruit trees were almost unknown. Three hundred years after they were set out, the English horticulturist, Charles Maries, found some of these trees still in vigorous condition.

“Few other fruits have the historic background of the Mango, and few others are so inextricably connected with the folk-lore and religious ceremonies of a great people. Buddha himself was presented with a mango grove, that he might find repose beneath its grateful shade.

“At the present time the Mango is a fruit of greater importance to millions throughout the tropics than is the apple to temperate North America.

“In the past twenty years, choice budded or grafted varieties have been planted in Florida and the West Indies, and the fruit has begun to appear in the markets of the North. The rich spicy flavor of the Mango, its peculiarly tempting fragrance, and the beautiful shades of color which characterize many varieties, make it one of the most attractive dessert fruits on the American market.

“In many instances, travelers have made the acquaintance of this fruit through some of the fibrous seedlings which abound in all parts of the tropical world, and as a result may have formed an aversion for it difficult to overcome. It is only in the superb grafted varieties of the Orient

the product of centuries of improvement, that the Mango exhibits its best qualities. There is more difference between an ordinary seedling and a grafted Alphonse than there is between a crabapple and a Gravenstein.

"Since the introduction of these choice varieties into tropical and sub-tropical America, mango culture has there taken on a new aspect. Previously limited to the production of seedling fruits usually of inferior quality though valuable for local consumption, the industry is now being developed with a view to supplying northern markets with fancy fruit.

"The mango tree is evergreen. Seedlings on deep rich soils often reach immense size. One measured in Bahia, Brazil, had a spread of 125 feet and a trunk 25 feet in circumference. Trees believed to be more than a hundred years old are common in the Orient; not a few such are to be seen in tropical America, but the comparatively recent introduction of the Mango into this hemisphere makes old trees less common than in India. Budded or grafted trees do not grow so large as do seedlings and are probably shorter lived.

"The crown is sometimes broad and round-topped; in other instances it is oval, giving the tree an erect or even slender form. The leaves are lanceolate, commonly to 12 inches in length, rigid, deep green, almost glossy, borne upon slender petioles 1 to 4 inches long. Growth is not continuous throughout a long season, but takes place in frequently recurring periods, each of which is followed by a period of inactivity. These periods of growth (commonly termed "flushes" by horticulturists) do not occur at fixed intervals, and in fact the whole tree does not always break out in new growth at the same time. It is a common occurrence for one side of the tree to be in active growth while the other side is dormant. The young leaves are usually reddish or coppery, and often hang limply from the ends of the branchlets. After the growth has begun to mature, they become turgid and soon lose their reddish color.

"The small pinkish white flowers are borne in large panicles at the ends of the branchlets. In Florida and the West Indies the flowering season extends from December to April. Sometimes the trees bloom two or three times during the season. More than 4,000 flowers have been counted on a single panicle, but not all of these are capable of developing into fruits, since the Mango is 'Polygamous'; that is, it produces two kinds of flowers: perfect ones having both stamens and pistils, and others which are unisexual. The unisexual flowers, which are staminate, commonly outnumber the perfect ones; usually, however, there is only one pollen-bearing stamen in each flower. The perfect blossoms are easily distinguished from the staminate by the presence in the former of the small greenish yellow ovary surmounting the white disk in the center.

"The fruit varies greatly in size and character. The smallest kinds are no larger than good-sized plums, while the largest are 4 or 5 pounds in weight. The form is oval, heart-shaped, kidney-shaped, round or long and slender. The skin is smooth, thicker than that of a peach, commonly yellow on the surface but varying greatly in color. Some varieties are delicately colored, deep yellow or apricot with a crimson blush on one

cheek; others are an unattractive green even when ripe. The color depends to a certain extent on the climate in which the fruit is grown. The aroma is often spicy and alluring, indicative of the flavor of the fruit. The flesh is yellow or orange in color, juicy, often fibrous in seedlings and inferior budded varieties, but in the best sorts entirely free from fibre and of smooth melting texture. The seed is large and flattened, its tough, woody husk or outer covering inclosing a white kernel. The flavor of the Mango has been likened to a combination of apricot and pineapple, yet it cannot be described accurately by any such comparison. It is rich and luscious in the best varieties, sweet, but with sufficient acidity and spiciness to prevent its cloying the palate."

WILSON POPENOE.

CLIMATE AND SOIL

"While the mango grows in humid tropical regions subject to heavy rains throughout the year, it is not successfully cultivated for its fruit under these conditions. It requires the stimulus of a dry season to fruit abundantly. To a certain extent this stimulus can be given by artificial means, but these can be no doubt that the best regions for commercial mango culture are those in which there is a well-marked dry season occurring at the proper time of year.

"This is illustrated by conditions in India. Lower Bengal is a humid region in which moisture-loving tropical plants are completely at home. Mango trees in this region are ragged in appearance, with foliage of an unhealthy color, and the fruit does not ripen well. In sharp contrast, the trees at Saharanpur, on the dry plains of northern India, are vigorous and stocky in habit, with abundant foliage of rich green color. They fruit more profusely than those in the moist lowlands, and the fruit ripens perfectly. Saharanpur lies at an elevation of 1,000 feet, and has an annual rainfall of about thirty-five inches. During the season when mangos are ripening, no rain falls and the air is hot and dry. Temperature of 100° F., continued throughout day and night, are common. The monsoon, or rainy season, lasts but a few months.

"The total amount of rainfall is not so important as the season during which it occurs. Where the dry season coincides with the normal flowering time of the Mango, good crops of fruit can be expected, but it seems doubtful whether the finer grafted mangos can be cultivated successfully in regions where there is much precipitation during the flowering season. Some of the seedling races will fruit under these conditions, but the choice Indian varieties are more exacting in their climatic requirements."

WILSON POPENOE.

(So when we have a damp rainy winter and spring in Florida, conditions for a good mango crop are unfavorable. Anthracnose, a microscopic fungus, attacks the young fruit and causes it to drop. Frequent applications of Bordeaux mixture or other fungicide will be more or less effective in counteracting this. Make the first application before the blossom is open, the second as soon as the fruit has set.)

Much more important than the mechanical or chemical composition, in most cases, is the drainage of the land. The mango avenue in the Botanic Garden at Rio de Janeiro illustrates this. If the subsoil is permanently wet or poorly drained, the tree cannot be expected to fruit properly.

While the Mango is more susceptible to frost than the hardier races of the Avocado, mature trees have withstood temperatures below the freezing point without injury. In general, it may be said that most varieties, if not in active growth at the time cold weather strikes them, will withstand 28° or 29° above zero, provided such temperatures are not of long duration. Young trees in vigorous growth may be injured seriously by a temperature of 32°. At Miami, Florida, five-year-old trees of one or two varieties were killed outright by a freeze of 26.5°. Old seedling trees have gone through temperatures lower than this without losing more than the smallest branches. The cultivated kinds show slight differences in hardiness. Observations have been made at Saharanpur and lists drawn up showing the relative susceptibility to frost of many varieties. The vagaries of the 1917 freeze in southern Florida, however, have resulted in an impression that much depends on local conditions, the physiological state of the tree, and other factors as yet not understood.

The Mango resists heavy winds much better than does the Avocado. The wood is tough, and ordinarily the tree (except in the Cambodina group) assumes a low, compact form if not crowded. It is essential, therefore, that the young tree be trained with a view to making it of such form that it will be able to withstand a hurricane or cyclone.

Mango culture in California presents some unusual aspects. Although experience is limited, it is apparent that the great variations in temperature between night and day, coupled with the comparatively cold winters, have the effect of retarding the growth of the tree, as well as preventing the rapid development of the fruit. The dryness of the climate, on the other hand, makes the tree bear at an early age and yield very heavily. In certain situations near the sea, the summers are so cool that the fruit does not ripen properly. This has proved to be true of Santa Barbara, Hollywood and San Diego. In the foothill regions, where the summers are warmer than near the sea, good mangos have been produced. It is necessary to protect the trees from frost while they are young; even large trees are sometimes injured by an unusually severe winter. All of the mangos which have fruited in California up to the present time have been seedlings or inferior budded varieties; only recently have budded trees of choice varieties been planted. Localities such as Glendora and Monrovia, which have warm summers and are comparatively free from winter frosts, are probably the most suitable for mango culture. The hot summer weather of such districts hastens the development of the fruit and brings it to maturity before the onset of cool weather in autumn.

Commercially, mango culture has never been considered promising in California. It should be possible to produce good fruit on a limited scale in a few of the most protected situations, but the greater number of

mango trees which have been planted in the state have been killed by frost.

In Florida, commercial mango culture is successful from Palm Beach on the east coast and Punta Gorda on the west coast down to the southern end of the peninsula. There are a few trees as far north as New Smyrna on the east coast and Tarpon Springs on the west, but the hazards are great in any except the warmest parts of the state.

The largest commercial plantings have been made in the vicinity of Miami. There are a few small groves near Palm Beach and Fort Myers.

In southern Florida the weather is normally dry during the flowering season. Sometimes there are light rains in this period, or many cloudy damp days. In such seasons many of the Indian varieties, notably Mulgoba, fail to bear good crops, although the seedling mangos which are found throughout this region fruit abundantly. Mangos differ in their ability to flower and fruit under adverse climatic conditions. Some of the Indian varieties will only flower after a period of three or four weeks of dry, sunny weather; certain Cuban seedling races (and those of other countries as well), on the other hand, will insist on flowering even though the spring months are unusually wet; and if one crop of flowers is destroyed by the anthracnose fungus, as is often the case, they will flower a second and even a third time in an attempt to produce fruit.

The soils of the Fort Myers region produces larger trees than those of Miami. The latter, which are mainly light sands underlaid with oolitic limestone, are nevertheless satisfactory when properly fertilized. The mango requires much less fertilizer than the avocado or the citrus fruits, but it only reaches large size when grown upon reasonably deep soil.

WILSON POPENOE.

CULTIVATION

The best site for the mango orchard is one which has good drainage together with soils of such nature that it will dry out thoroughly when no rain falls for a few weeks. In regions where the soil is deep and the trees consequently grow to large size, they should not be set closer than 35 by 35 feet. There are dwarf varieties, such as D'Or, which can be set much closer than this, but most of the Indian kinds ultimately make trees of good size. G. Marshall Woodrow recommends planting 20 by 20 feet, but in America this has not been found a good practice. Closer planting than 30 by 30 feet is undesirable except with dwarf varieties. Seedlings grow to larger sizes than budded or grafted trees, and need proportionately more space. On deep soils they will usually come to crowd each other in time if planted less than 40 or 45 feet apart.

April and May are considered the best months for planting in Florida. Midsummer planting is, however, much more successful than with the Avocado. The principal point to be observed is the condition of the young tree at the time of planting. If it is not in active growth, it can be set at almost any season of the year, provided the weather is warm. In India it is recommended to plant at the beginning of the rainy season.

Holes 2 to 3 feet broad and deep should be prepared in advance of planting. Woodrow recommends that 20 pounds of fresh bones be placed in the bottom of each hole before filling in the soil. In Florida a small amount of commercial fertilizer is commonly used. The object in preparing the holes is the same as in planting other fruits, viz: to loosen the subsoil so that the roots can develop readily in all directions, and to place in the ground a supply of food for the young tree. It is sometimes recommended that stable manure be incorporated with the soil; this is a desirable practice, but it should be kept in mind that stable manure is not, generally speaking, suitable for bearing mango trees.

Well grown budded or grafted trees, when shipped from the nursery, are 18 inches to three feet in height, with stems one-half inch in thickness. They should be stocky and straight, with foliage of rich green color.

As soon as the young trees have been planted in the field, they should be shaded with a light framework covered with burlap or other cheap material. Palm leaves and pine boughs may be used for this purpose. The trees should, of course, be watered liberally as soon as they are planted, and in most regions the ground around the base of each should be mulched with straw or other loose material.

During the first four or five years, the trees should be encouraged to make a vigorous, rapid growth. After that, the aim of the orchardist is to make them produce good crops of fruit. The object of early culture is, therefore, distinct from that of later years and somewhat different methods are required. The young growing trees can be given both water and fertilizer in liberal quantities; the mature tree, on the other hand, must be encouraged to flower and fruit by withholding water and fertilizer during certain portions of the year.

It must be admitted that the cultural requirements of the Mango are not yet thoroughly understood. Varieties differ greatly in their reaction to the stimulus of tillage, irrigation and manuring. A thorough study has not yet been made of the requirements even of a single variety. Horticulturists in India have devoted a limited amount of attention to the subject; but the Mango seems to differ so markedly from other fruits which have been subjected to systematic cultivation that much further study will be needed before its habits are thoroughly understood.

The amount and character of tillage given to the orchard varies in different regions. In most parts of the tropics little attention is given to the mature trees. The soil beneath its spreading branches is often firmly packed down by the hoofs of domestic animals; or weeds may be allowed to grow unchecked. Needless to say, such treatment has little to recommend it. In Florida the land is sometimes given shallow cultivation during part of the year, and at other seasons leguminous cover-crops may be grown upon it, particularly if the orchard is not yet of bearing age. It is evident that the amount of nitrogenous fertilizer required by bearing groves is small. Over-stimulation results in vigorous development of foliage but no fruit.

Growers of grafted mangos in India resort to various expedients to check the vegetative activity of the tree and encourage the development of fruit. Thomas Firminger* says: "The Mango, like all other trees, is much benefited by having the earth around it removed, and the roots left exposed for a space of two or three weeks. This should be done in November, and in December the roots should be well supplied with manure, and then covered in again with entirely fresh earth, and not that which had been previously removed." Woodrow notes that "The mango growers near Mazagon, Bombay, who produced such famous fruit before the land was occupied with cotton mills, applied ten pounds of salt to each tree at the end of September; this would arrest growth in October and November, and encourage the formation of flower buds. In a moist climate, and the intervening ground occupied with irrigated crops, this system is highly commendable, but with a dry climate it is unnecessary."

The failure of many varieties to fruit abundantly is often attributed to imperfect pollination, attacks of insect pests, and other causes which are discussed in a later paragraph. It seems probable that too much emphasis has in the past been placed on these factors, and that the problem is largely a physiological one, connected with the nutrition of the tree. It is for this reason that the two quotations above are illuminative. They show that the nutritional problem has been recognized by early students of mango culture; yet no one has taken up the subject in sufficient detail to master it.

The mango requires less water than the avocado, although the young trees are benefited by frequent irrigations. In Florida, old mango trees will be found growing and fruiting in fence corners and abandoned gardens where they have to depend entirely on rainfall. They are much more successful under such conditions than the Avocado. Orchards of budded or grafted trees are rarely irrigated after the trees have attained a few years' growth.

All writers point out the necessity of applying a check to vegetative growth previous to the flowering season. Ringing and hacking the trunk are two of the commonest practices, while root-pruning is occasionally performed in India. Recent experiments indicate that a liberal application of potash is extremely beneficial. Mulgoba trees at Miami, Florida, and Guanajay, Cuba, which were heavily fertilized with potash, produced much larger crops than those fertilized in the ordinary way. A standard commercial fertilizer especially prepared in Florida for use on mango trees contains:

| | |
|-----------------------|----------|
| Ammonia | 5 to 6% |
| Phosphoric Acid | 7 to 9% |
| Potash | 9 to 11% |

These elements are derived from ground bone, nitrate of soda, dried blood, dissolved bone black and high-grade potash salts.

*Manual of Gardening for India.

Numerous experiments to test the effectiveness of girdling and root-pruning have been made at the Porto Rico Agricultural Experiment Station. C. F. Kinman reports of them:

"Girdling, branch pruning and root pruning are common practices, but they should be used with caution and moderation, as a tree may easily be so severely injured as to prevent its bearing for one or more seasons. Pruning back the ends of the branches to induce blossoming has been practiced with good results at the station. In the operation, from a few inches to a foot of the end of the branch was removed, depending upon the stage of maturity of the wood, leaving a few nodes from which the leaves had not fallen. From these nodules blossoms developed profusely, no blossoms appearing on untreated branches. To secure best results, the pruning should be done in the late summer or fall, several months before the blossoming time. . . ."

Experience in Florida has shown that girdling, to be effective, must be done in late summer. No one yet has had sufficient experience to recommend it as an orchard practice. Like root pruning, the use of salt, and several other unusual practices, it may prove of decided value when its proper method of use has been determined. Every grower should conduct a few carefully arranged experiments along such lines as these, even though on a limited scale.

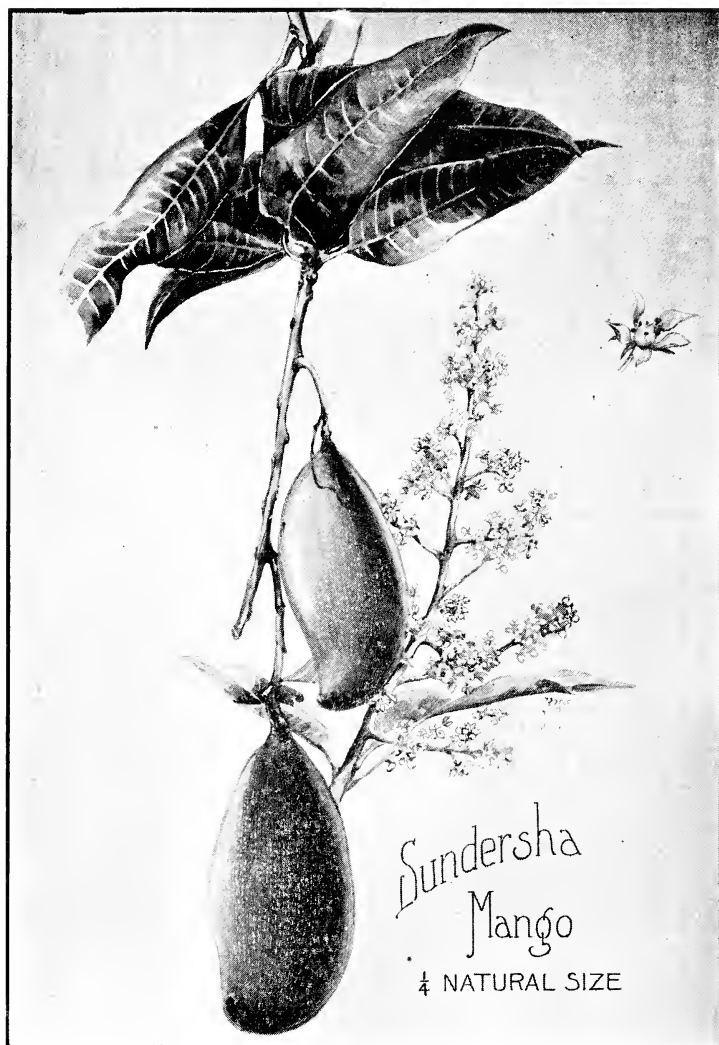
In India, the only pruning usually given the Mango consists in cutting out dead wood. Since the fruit is produced at the ends of the branchlets, general pruning of the top cannot be practiced as with northern fruits. In Florida, however, several growers have found it desirable to prune out a certain number of branches from the center of the tree, so as to keep the crown open and admit light and air.

WILSON POPENOE.

PROPAGATION

Like many other fruit trees, the Mango has been propagated in the tropics principally by seed. In some instances seedling trees produce good fruits; this is particularly true of certain races, such as the Manila or Philippine. But in order to insure early bearing, productiveness and uniformity of fruit, it is necessary to use vegetative means of propagation. Inarching, budding and grafting are the methods most successfully employed.

The seedling races of the tropics are, so far as has been observed, polyembryonic in character. Three to ten plants commonly grow from a single seed. Since these develop vegetatively from the seed tissues, they are not the product of sexual reproduction, but may be compared to buds or cions from the parent tree. Most of the grafted Indian varieties, on the other hand, have lost this characteristic. When their seeds are planted a single young tree develops, and this is found to differ from its parent much as does a seedling avocado or a seedling peach. Usually the fruit is inferior, and the tree may be quite different in its bearing habits.



THE CROP

In the tropics seedling mangos usually come into bearing four to six years from the time of planting. More time than this may be required in some instances. Certain races are more precocious than others.

The extensive tests which have been made in Florida have brought to light a number of choice sorts which combine excellent quality of fruit with a degree of productiveness far above the average. *Sundersha* has produced a fair crop nearly every year. The varieties now grown in Florida supply the market with ripe fruit from July to October. The main season is August and September. *Sundersha* is probably the latest variety. A few of its fruits ripen as late as the first half of October.

From Florida, the Indian varieties have been shipped successfully to northern markets. The fruit is packed when it has begun to acquire color, but before it has softened in the slightest degree. It is then wrapped in tissue paper of the kind used in shipped citrus fruits, and is packed in tomato baskets. Mangos of moderate size, such as *Mulgoba*, will pack twelve to a basket. A small amount of excelsior is used above and below them. Six of these baskets are dispensed with and the fruit is packed in a crate with a partition in the center, using an abundance of excelsior between each tier or layer.

Numerous storage tests have been made at the Porto Rico Agricultural Experiment Station (Bulletin 24). Mangos of different varieties were placed in (a) warm storage at 80 to 83° F., and (b) cold storage at 40 to 47° F. Some of the results were as follows:

SUNDERSHA: Fruits picked just before they begin to soften and placed in the warm room were ready for eating nine days later, and remained in good condition three days. Fruits picked similarly mature and placed in the cool room remained in good condition for nearly five weeks, at the end of which time the flavor was better than that of tree-ripened specimens.

When the fruit is only to be shipped from Florida to New York, keeping quality is not so important. Some mangos which have been placed on the market have made an unfavorable impression because they were improperly ripened. More attention must be given to methods of ripening in the future, so that the fruit may reach the consumer in full possession of its delightful flavor and aroma.

PESTS AND DISEASES

The commonest and most troublesome enemy of the Mango in tropical America is anthracnose. This is a parasitic fungus (*colletotrichum gloeosporioides* penz) which attacks many different plants, and is particularly known as the cause of wither-tip in citrus fruits. It is a species of wide distribution which springs up with no evident center of infection whenever the weather is warm and moist. On the flowers and flower stalks of the Mango, it appears in the form of small blackish spots. Often it causes many of the flowers to drop. On the leaves, spots and sometimes

holes are produced; these begin as minute black dots and enlarge until they are about an eighth of an inch in diameter. Young fruits may be attacked and made to drop in large numbers, while older fruits become spotted with black, or streaked, and their keeping qualities are impaired.

S. M. McMurran, who studied anthracnose control methods in Florida and reported his results in Bulletin 52 of the United States Department of Agriculture, says:

"Spraying before the buds begin to grow is of no value so far as protecting the inflorescence, and later the young fruit, is concerned. These must be kept covered with the fungicide (Bordeaux mixture) while growing, if fungus invasion is to be prevented. The difficulty of so protecting the inflorescence is at once apparent. Elongations of the panicle continue for a period ranging from 10 to 15 days. Those which were sprayed every third day were practically all disease-free when the flowers began to open. This, however, required four sprayings in one case and six in the other. Those sprayed every fourth day showed but little more disease than those sprayed every third day, but those on which the spray was applied at five and six day intervals had traces of disease, showing that they were less perfectly protected.

"The spraying of the inflorescence at least three times, beginning when the buds are just swelling and repeating every fourth day until the flowers open, will help to prevent the dropping of fruit caused by the disease on the peduncles and pedicels.

"The inflorescence may be kept in a clean condition up to the time of blooming; but, when this takes place, immediately there are hundreds of points which are not covered by the fungicide and are open to infection; . . . spraying is of little or no value in controlling the blossom blight form of the disease, and profitable sets of fruit can be expected only during seasons which are dry at blooming time, unless varieties which are resistant to the disease are developed and cultivated."

In Florida, red spiders and thrips are responsible for extensive injury to foliage, leading to disturbances of the general health of the trees; but contact spray, e. g., lime-sulphur or nicotine, properly applied, will effect complete eradications.

These and many other insects reported as attacking the mango in various parts of the world are described in "A Manual of Dangerous Insects," published by the United States Department of Agriculture (1927).

RACES AND VARIETIES

"The classification of mangos must be considered from two distinct standpoints. First, there are numerous seedling races; and second, there are horticultural groups of varieties propagated by grafting or budding.

"The seedling races have not been studied in all parts of the tropics. Most of those in America now are fairly well known, but they are probably few compared to those of the Asiatic tropics. The latter region has not been explored thoroughly.

"So far as is known, all the seedling races are polyembryonic. Individuals reproduce the racial characteristics with remarkable constancy. Numerous writers have said that these races (incorrectly termed varieties) come true from seed, and that there is no need of grafting or budding. There is enough variation among the seedlings, however, to make some of them more desirable than others. When one has been propagated by budding or grafting, it becomes a true horticultural variety.

"The abundance of grafter mangos has led Indian investigators to neglect the seedling races.

"SUNDERSHA GROUP: The tree is erect, stiff, with the crown less broad than in the Mulgoba group and usually not so umbrageous. The foliage is fairly abundant, deep green color, the leaves comparatively small but broad, with primary transverse veins 18 to 24 pairs, moderately conspicuous. The panicle is small to large, broad toward the base, 8 to 18 inches long, stiff, the axis and laterals deep magenta-pink to bright maroon, the pubescence very minute and inconspicuous. The flowers are abundant but not closely crowded on the panicle. The staminodes are weakly developed, rarely capacitate or fertile. Varieties of this group often flower in unfavorable weather, and they remain in bloom during a long period. On the whole, the group is characterized by a higher degree of productiveness than any other class of Indian mangos yet grown in the United States. The fruit is long, usually tapering to both base and apex and terminating in a prominent beak at the apex, large in size, deep yellow in color, the flesh orange-yellow and free from fiber. The somewhat acid flavor makes the mangos of this group more valuable as culinary than as dessert fruits. The seed is long, containing normally one embryo, the cotyledons often not filling the endocarp completely."

WILSON POPENOE.

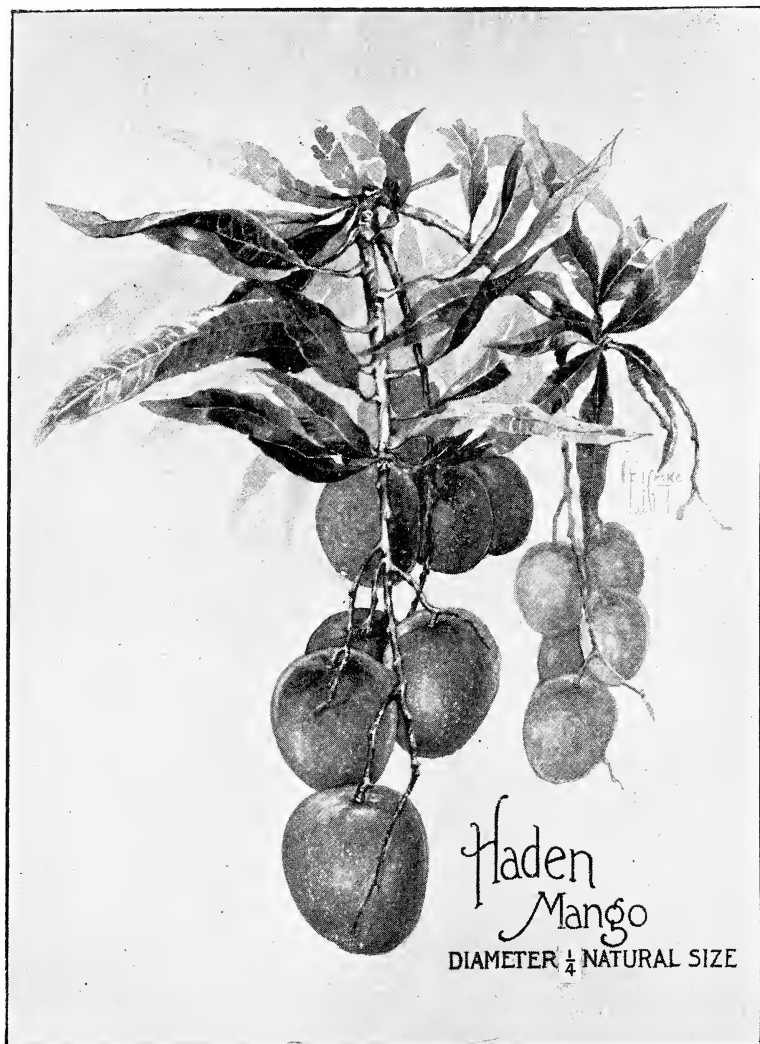
RAJAH, or RAJPURY: Average 12 ounces in weight; almost round, yellow with pink cheek; flavor rich and buttery; both flavor and aroma distinct from any other mango; very prolific.

HADEN: This is a seedling from Mulgoba, and is very highly prized, being almost identical with Mulgoba, but freer from fungus. It averages handsomer in appearance, a more reliable bearer, and almost as good in quality. Tree is also an exceptionally vigorous grower. This is the main standby for commercial planting. Weight 1 to 2 pounds.

AMINI: Most prolific and reliable bearer of the East Indian type of mangos. Very showy lemon yellow with carmine cheek; no fiber; high aroma; delicious flavor. Size small (6 to 12 ounces). This variety seems to be practically immune to fungus attacks.

BROOK'S LATE MANGO

This is a natural hybrid, originating as a seedling of *Sundersha*, pollinated by East Indian type pollen, probably from *Mulgoba*. The fruit combines the shape of the *Sundersha* with the rich musky flavor and



aroma of the East Indian type. It appears to be quite as prolific as the female parent, which is saying a good deal, and it does not have the unfortunate tendency to crack, which is so objectionable in the *Sundersha*. With no further advantages it would be a fruit well worthy of cultivation and everybody would want to have it in their orchards, but it seems to have enlarged and developed another valuable trait of the *Sundersha*, namely, bearing out of season. The original tree has produced four crops which matured from September to as late as December. A large tree which has been topworked from the original has also produced late fruit, and is the only specimen now left bearing, as the old tree has been practically destroyed. I do not claim that the entire crop is always very late, for it produces fruit in the summer, but it seems to be the only mango which has any pronounced tendency to make any sort of fall and winter crop.

CHINESE TYPE

(The two following are the Chinese strain and, originating in a very rainy region, are hence supposed to be more immune to fungus.)

CECIL: This variety is very long and slender in shape, and has been found very attractive in the New Orleans market. It originated as a seedling from seed brought from the Phillipines to Mexico, and seed from there planted at Miami by the late Samuel Belcher.

SUNDERSHA: Weight 2 to 3 pounds. Very prolific and of fair quality, with little fiber, but must be cut green and used for cooking, as it generally cracks and begins to decay when three-fourths grown.

SAPODILLA (*Achras Sapota*)

The Sapodilla is a native of tropical America. All the chewing gum manufactured in the United States has as its base the gum from this tree, which is known as chicle. It is a symmetrical, glossy-leaved, evergreen tree. It is very ornamental and an excellent shade tree.

The fruit has the color of a russet apple and the pulp is grainy like that of some pears. The flavor is very rich and sweet and juicy. It is a poor shipper, however, and only good for local or nearby markets.

The seedling trees produce fruit of varying size and shape and quality, ripening in the spring and early summer.

The Sapodilla must be considered one of the best fruits of tropical America. It cannot, perhaps, vie with the Pineapple or the Cherimoya, but it is deservedly held in great esteem by the inhabitants of many tropical countries.

The tree is evergreen and stately, sometimes attaining a height of 50 to 75 feet, with a dense rounded or conical crown. The wood is hard and

durable. The flavor of the fruit has been likened to that of pears and brown sugar together; it is rich, slightly fragrant, and very pleasing to those who like sweet fruits. The seeds vary from none to ten or twelve and are hard, black, shining, obovate, flattened and about three-fourths inch long. They are easily separated from the flesh and give little trouble in eating the fruit.

In California, the sapodilla has not been a success. Occasional trees in favored locations have lived for several years, but they have never reached the fruiting stage. Frosts have eventually killed most of them, and even the coolness of California nights has proved unfavorable to their natural development. In Florida the plant's cultivation is limited to the east coast from Palm Beach (or perhaps farther north) southward to Key West, and on the west coast as far north as the Manatee River. Mature trees in this state have passed uninjured through temperatures of 28° above zero, according to P. W. Reasoner. On the Florida Keys, the sapodilla is one of the favorite fruits.

The common name, sapodilla, by which the fruit is known in Florida, is taken from the Spanish zapotillo, meaning small zapote.

The sapodilla is preeminently a dessert fruit. Rarely is it cooked or preserved in any way, although in Cuba and Brazil, it is often made into a sherbet. According to Carl Wehmer, it contains about 14% of sugar, of which 7.2 is saccharose, 3.7 dextrose and 3.4 levulose. It also contains a small amount of acid and about 1% of ash.

Although tropical in character, the sapodilla does not require a high degree of humidity nor entire freedom from frost. If liberally irrigated it can be grown in regions where the atmospheric humidity is low. The plant while young is injured by temperatures below freezing, but when mature it withstands 27 or 28° above zero. Although it prefers a rich sandy loam, it thrives on light clay and also on the shallow sandy soil underlaid with soft limestone, which is found on the lower east coast of Florida. Indeed, its aptitude for rocky and forbidding situations on the Florida Keys is remarkable.

It is the custom in India to plant sapodilla trees 15 to 20 feet apart. This is too close for the best results, particularly if the soil is rich and deep so that the tree grows to large size; 30 feet apart is probably close enough on good soils. V. M. Gokhale writing in the Poona Agriculture College Magazine (1911), reports that in India the young plants are set in pits 1 foot wide and 2 to 3 feet deep, in which a quantity of sheep manure has been mixed with the soil, and that the mature trees are regularly supplied with manure two or three times a year.

Little attention has yet been given to pruning. Since the tree is of slow, compact growth, it will probably require nothing more than the removal of an occasional unshapely branch. In southern Florida it thrives under the same cultural attention as citrus fruits.

The Sapodilla is usually propagated by seed, but the variation among seedlings in productiveness as well as in quality, size and shape of fruit

necessitates some asexual means of propagation if the most desirable forms are to be perpetuated. Edward Simmons has shown in Florida that the species can be budded in the same manner as the mango.

In southern Florida, May has proved to be a good month for budding; in strictly tropical regions it can probably be done at any time of the year, provided the stock-plants are in active growth. Budwood should be chosen from young branchlets which have begun to lose their greenish color and assume a brownish tinge. It should be examined carefully to ascertain that the auxilliary buds or "eyes" are well developed. Shield-budding is the method employed, the details being practically the same as for budding the Mango. After making the incision in the stock, the bud should be inserted promptly, since the latex soon collects around the wound and renders insertion difficult. Waxed tape should be used for wrapping. After three or four weeks, the stock may be headed back and the wrap loosened, leaving the eye exposed so that it may start into growth.

Experiments have shown that the fruit can be shipped successfully and with little care in packing. The skin is thin and delicate and the fully ripe fruit is injured very easily; but if picked while still hard or "tree ripe", it does not begin to soften for several days. Sapodillas have been shipped from the Florida Keys to New York, packed in tomato crates which hold six small baskets, each basket carrying six good-sized fruits. For local consumption, or for shipping short distances, the common procedure in Florida is to pull the fruits from the trees and simply throw them into boxes or baskets, in which they are carried to market, the ripe ones being picked out daily.

Seedling sapodillas rarely come into bearing until six to eight years of age, even when grown under favorable conditions. They usually fruit heavily, and often produce two crops a year, one being much lighter, however, than the other. Due to this habit, together with the natural variation in season among seedling trees, ripe sapodillas are to be found in the markets of tropical America almost throughout the year.

SAN BLAS (Grafted): This variety weighs from 8 to 12 ounces and is quite productive and of a very superior quality. Bears in three years.

LOQUAT (*Eriobotrya Japonica* Lini)

The Loquat or Japanese Medlar or Japan Plum is a most ornamental evergreen tree with a dark green corrugated foliage. It has blossoms like the horse chestnut in the fall, and produces clusters of orange-colored fruit in February, March and April. In flavor, it is between an apple and a grape and makes most excellent jelly, preserves and pies.

To produce the full flavor in cooking, the seed should be left in the fruit. The seed adds a flavor like bitter almond. Some people prefer the jelly made after removal of the seed, which will then closely resemble currant jelly.

To northern residents and travelers in tropical and sub-tropical countries, the Loquat should possess an especial attraction, inasmuch as it recalls in flavor and character the fruits of the North. As a matter of fact, it is closely related to the apple and the pear, while its flavor distinctly suggests the cherry. Those whose palates have been educated to demand the subacid, sprightly flavored fruits of the temperate zone often criticize tropical fruits as being too sweet and rich. The Loquat is not open to this objection, and it can be grown throughout the tropics wherever there are elevations of a few thousand feet.

To reach its greatest perfection, the Loquat requires particular climatic conditions. Quite satisfactory results are obtained with it, however, in situations where the plant cannot realize its best possibilities. The tree is simple of culture, and has become widely distributed throughout the tropics and subtropics.

Not until rather recently has it been planted in regions where systematic attention is given to the improvement of fruits; hence its development to meet the ideals of European and American pomologists, while accomplished in part, is still far from complete. The progress made during the last twenty years is highly encouraging, and several varieties now available are sufficiently good to merit extensive cultivation.

Because of its ornamental appearance alone, the Loquat is often planted in parks and gardens.

Numerous varieties have originated in Japan, the best of which have been introduced into the United States and a few other countries.

W. J. Krome has had signally good results with this fruit at Homestead.

Although most commonly eaten as a fresh fruit, the loquat can be utilized in several ways. For culinary purposes it is nearly as useful as its temperate zone relative, the apple; it may be stewed and served as a sauce, or it may be made into excellent jelly. Loquat pie, if made from fruit which is not fully ripe, can scarcely be distinguished from the renowned article made from cherries.

Table V. Composition of the Loquat

| Variety | Water % | Protein % | Fat % | Sugar | | | Fiber % | Ash % |
|----------------|------------|--------------|----------|---------------|--------------|--|------------|----------|
| | | | | Dextrose % | Sucrose % | | | |
| Thales ----- | 89.0 | 0.35 | 0.06 | 8.95 | 0.94 | | 0.30 | 0.29 |
| Champagne ---- | 84.0 | 0.32 | 0.03 | 11.96 | 0.83 | | 0.37 | 0.36 |

CULTIVATION

The climatic requirements of the loquat, except as an ornamental plant, are distinctly subtropical. It is not successful in hot tropical lowlands, nor can it be grown for fruiting purposes in regions subject to more than a few degrees of frost. Cool weather during part of the year and a rainfall of 15 to 50 inches (with artificial irrigation where the dry

season is severe) suit it best. These conditions are found in southern Japan, in parts of southern California, along the shores of the Mediterranean, and in several other regions. It has been noted in Japan that the best loquat situations always lie close to the sea; and in California much finer fruit has been produced near the coast than in the foothill tracts twenty to thirty miles inland. Thus it seems that the mild climate of the seacoast is peculiarly favorable to the development of the fruit.

While mature trees have withstood temperatures as low as 10° above zero without serious injury, the flowers and young fruit may be killed by temperatures only a few degrees below freezing; hence loquats cannot be produced successfully where heavy frosts may occur at the time of flowering.

Sandy loam is considered the ideal loquat soil, and it should be of good depth. Several other types of soil have proved satisfactory; thus, in southern California good orchards have been produced on heavy clay of the adobe type, and in Florida the shallow rocky soils of the Homestead region on the lower east coast have given excellent results. Deep sandy soils, when of little fertility, are not suitable. Frank N. Meyer points out that the best loquat orchards in China are situated on low, rich, moist land.

In southern Florida, the best time for planting is probably in the autumn.

The amount of tillage given the orchard varies in different regions. Condit says: "Clean culture may be practiced throughout the season, but the growth either of a winter or a summer leguminous cover-crop is much more advisable." In Florida and other regions, different methods of cultivation may be required, but the liberal use of green cover-crops seems universally desirable.

It is ordinarily considered that the amount of water required by loquat trees corresponds closely to that needed by citrus fruits. Probably it would be more accurate to say that the Loquat is more drought-resisting than any of the citrus fruits, but that the best results are obtained when the orchard is irrigated as liberally as the citrus orchard.

The young tree should be headed 24 to 30 inches above the ground, and three to five main branches forced to develop. The loquat is a compact grower, and the mature tree requires much less pruning than most of the temperate zone fruits. It has been found by C. P. Taft, however, that a certain number of branches must be cut out from time to time in order to limit the amount of fruiting wood and to admit light to the center of the tree. It must be remembered that the tendency of the Loquat is to overbear, and for the production of commercially valuable fruit, this must be checked by pruning and thinning. The best time for pruning is soon after the crop has been harvested.

PROPAGATION

In many countries it is still the custom to propagate the Loquat by seed, but in regions where the commercial cultivation of this fruit has received serious attention, this method has been replaced by budding and

grafting. Seedling loquats are no more dependable than seedlings of other tree-fruits. As ornamental trees for parks and dooryards, they can be recommended, but they will not serve when commercially marketable fruit is required.

YIELD AND PICKING

The Loquat tree is productive, and a regular bearer. Barring crop failures due to severe frosts at flowering time, the trees rarely fail to produce well every year. Their tendency is to overbear, with the result that the fruits are apt to be undersized. It has been profitable to thin the crop, since the increased size of the fruits remaining on the trees more than compensates for the loss of those removed.

The season during which loquats are marketed in California extends from the latter part of February to June. A given variety may ripen several weeks earlier in one locality than in another. In Florida the season is considerably earlier than in California. The fruits should be left on the tree until they are fully ripe, unless it is desired to use them for jelly or for cooking. Unripe, the loquat is decidedly acid, whereas the fully ripe fruit is sweet and delicious. Clippers such as are used by orange pickers are employed in gathering the fruit. Sometimes whole clusters can be picked, and again it may be necessary to clip off two or three ripe fruits and leave the remaining ones to mature.

The fruit is sorted and graded by hand. For shipping to nearby markets, it is packed in thirty-pound wooden boxes ("lug boxes") without the use of excelsior, straw or other soft material to prevent bruising. For distant markets, smaller packages and considerable care will be required, since the fruit is bruised rather easily.

In Florida the flowers are sometimes blighted by the anthracnose fungus (*Colletotrichum gloeosporioides* Penz). Bordeaux mixture, prepared according to a 3-3-50 formula, should be used to combat this disease.

THE PAPAYA

The Papaya or "melon pawpaw" is remarkable from the fact of its containing a natural pepsin which will digest meat and most other foods in the same manner as the pepsin of the stomach.

The tree begins bearing in from five to ten months and produces large yellow melon-like fruits, some of which have been known to weigh as high as twenty pounds apiece.

Besides being an excellent substitute for the Cantaloupe as a breakfast fruit, they are a great boon for dyspeptics or those who have weak stomachs, as the pepsin performs its digestive functions equally well

under acid or alkaline conditions, and continues to digest the food as long as it remains in the alimentary canal.

While grafting is possible, it is not satisfactory, and we have abandoned it, as the seedlings, when carefully grown, produce reasonably true to type. As a percentage of the trees turn out to be unproductive or inferior, it is best to plant two or three together in one hill and when they come into fruiting, leave only the best one, destroying the others.

The pepsin is contained in the leaves and tree as well as the fruit.

These trees are box grown in $5\frac{1}{2} \times 5\frac{1}{2} \times 12$ inch boxes.

The Papaya (sometimes called pawpaw) and the Passion-flowers are closely related, and the fruit-bearing kinds are treated together in this chapter. Some botanists place them all in one family even though the Papaya is an erect plant and the Passion-flowers are tendril-bearing vines; but recent botanists separate them into the Caricaceae (or Papayaceae) and Passifloraceae. In botanical structure, the fruits are very similar, and they are related not distantly to the Cucurbitaceae (pumpkins and melons).

Alice R. Thompson, of Hawaii, has published the following analyses of several different seedling strains grown at Honolulu:

Table IV. Composition of the Papaya

| Strain | Total Solids | Ash | Acids | Protein | Total Sugars | Fat | Fiber |
|--------------------|--------------|-----|-------|---------|--------------|-----|-------|
| | % | % | % | % | % | % | % |
| Trinidad ----- | 12.14 | .53 | .06 | .43 | 9.72 | .06 | .78 |
| South Africa ----- | 13.00 | .54 | .09 | .68 | 10.73 | .07 | .81 |
| Honolulu ----- | 12.20 | .56 | .07 | .50 | 10.29 | .05 | .66 |
| Barbados ----- | 11.72 | .48 | .06 | .46 | 8.05 | .06 | .76 |
| Panama ----- | 14.41 | .90 | .14 | .50 | 11.12 | .25 | 1.09 |

The sugar found in the Papaya is principally invert sugar, only traces of sucrose being present.

CULTIVATION

The Papaya is tropical in its requirements, but it can be grown in regions where light frosts are experienced. It prefers a warm climate and rich, loamy, well-drained soil. In southern Florida it grows best on hammock soils, but it is successful on high pine lands if properly fertilized. On the Florida Keys the plant has become thoroughly naturalized and springs up wherever a clearing is made, the seeds being scattered by birds and other agencies. While commercial papaya culture probably should not be attempted north of Palm Beach, good fruits are occasionally produced in the central part of the state when a mild winter allows the plants to reach fruiting age without injury.

Higgins and Holt, whose bulletin, "The Papaya in Hawaii,"* is the most valuable contribution yet made to the literature of papaya growing, have the following to say concerning climate and soil:

"In regard to rainfall and moisture requirements, the plant is able to adapt itself to a wide range of conditions, and when established suffers much less from a shortage of water than the Orange or the Avocado, but makes beneficial use of a large amount, if supplied. Yet, withal, it is one of the most insistent plants in the matter of drainage. In waterlogged soils the papaya makes a spindling growth and drops its lower leaves prematurely, while the remaining foliage becomes yellow, the whole plant indicating an unhealthy condition.

"There are few, if any, soils in which the Papaya will not grow if aeration and drainage are adequately supplied. Most of the plantings at this station are upon soils regarding as unsuitable for other fruit trees and upon which the Avocado is a failure. . . . They are very porous, permitting perfect drainage and aeration. Rich soils give correspondingly better and more permanent results if they permit of the free passage of water and entrance of air."

For a permanent orchard, the plants should be not less than 10 feet apart. The Papaya is short-lived and will not usually remain in profitable bearing more than three to five years. That it is extremely simple of culture is proved by the ease with which it becomes naturalized in tropical regions, and by the thriftiness of the wild plants which spring up everywhere along the roadside.

YIELD AND MARKET

In the tropics papayas are in season during a large part of the year and the yield is enormous, a single plant bearing in the course of life (not more than a few years) a hundred or more immense fruits. In Florida the season extends from December to June, with a few fruits ripening at other times.

If the fruits are to be sent to market they should be picked as soon as the surface begins to turn yellow. Certain varieties become ripe enough for serving while showing little yellow coloring. It is difficult to ship the fully ripe fruit, since it is large, heavy and has no firm outer covering, but only a thin membranous skin, to protect it. For this reason papayas must be shipped before they are fully ripe, and even then great care is necessary. When shipped from southern Florida to New York by express, the percentage of loss is usually large, unless the fruit is picked while still green; and in the latter case, it does not ripen properly after reaching the market. It is advised to encase the fruits in cylinders of corrugated strawboard and pack them in single tier cases holding four to six fruits.

*No. 32 of the Hawaii Experimental Station.

GUAVA (*Psidium Guajava*)

The common tropical guava is the commercial fruit from which the typical jelly, jams and conserves are made.

It is to a large extent ever-bearing, like most tropical fruits, and while it is not a good shipper, it is invaluable for home use and nearby markets.

Its peculiar taste is disagreeable to some people and the hard seeds (like large currant seeds) which it contains are objectionable. With these two reservations it is a most desirable fruit for general use.

Cut up with sugar and cream it is more palatable than peaches, and it makes a better shortcake than strawberries, although it is necessary to remove the seeds with a collander or otherwise, before serving.

It is probably the most productive fruit tree in the world. It forms a low hardwood tree or bush and begins bearing very young. The size, quality and yield of older trees is generally improved by severe pruning, for when the trees get old, the fruit generally becomes smaller and more seedy.

They are not a long lived tree in Florida, like the Mango, generally dying off at from 15 to 30 years of age, so it is well to replant to keep up a succession.

They may be planted twelve feet apart. Culture the same as citrus.

Wilson Popenoe says:

"The guava, while useful in many ways, is preeminently a fruit for jelly-making and other culinary purposes. To the horticulturist the species is admirable as being one of the least exacting of all tropical fruits in cultural requirements, for it grows and fruits under such unfavorable conditions, spreads rapidly by means of its seeds. It is a fruit of commercial importance in many countries and one whose culture promises to become more extensive than it is at present, for guava jelly is generally agreed to be facile princeps of its kind and is certain to find increasing appreciation in the temperate zone.

"The guava tree grows from 25 to 30 feet. The fruit is 1 to 4 inches in length, commonly yellow in color, with flesh varying from white to deep pink or salmon red.

"The native home of the Guava is tropical America. The plant is said by P. W. Reasoner to have been introduced into Florida from Cuba in 1847 (?). It is now naturalized here in many places and cultivated in many gardens. It is successful as far north as the Pinellas peninsula on the west coast and Cape Canaveral on the east, but has been grown even farther north. If frozen down to the ground, the plant sends up sprouts which make rapid growth and produce fruit in two years.

"In Brazil a thick jam, known as gorabada, is manufactured and sold extensively. A similar product is made in Florida, under the name of guava cheese or guava paste.

"An analysis at the University of California showed the ripe fruit to contain water 84.08, ash 0.67, protein 0.76, fiber 5.57, total sugars 5.45 (sucrose none), starch, etc., 2.54, fat 0.95."

The Guava succeeds on nearly every type of soil. Mature plants have been injured by temperatures of 28 to 29°, but the vitality of the Guava is so great that it quickly recovers from frosts which may seem to have damaged it severely. Young plants, however, may be killed by temperatures of only one or two degrees below freezing. As regards moisture, writers in India report that the Guava prefers a rather dry climate.

The plants may be set from 10 to 15 feet apart, the latter distance being preferable. They should be mulched with weeds, grass or other loose material immediately after planting. In certain parts of India, where guava cultivation is conducted commercially on an extensive scale, it is the custom to set the plants 18 to 24 feet apart. Holes 2 feet wide and deep are prepared to receive the trees. Occasionally the soil is tilled and once a year each plant is given about 20 pounds of barnyard manure. During the dry season the orchard is irrigated every ten days. Very little pruning is done.

Seedling guavas do not necessarily produce fruit identical with that from which they sprang. It is the custom in most regions to propagate the Guava only by seed, but choice varieties which originate as chance seedlings can be perpetuated only by some vegetative means of propagation, such as budding or grafting.

The proper season for planting varies in different regions: in Florida, October and March are good months.

Both shield budding and patch budding are successful with the Guava. Shield budding is the better method of the two. The stock plants should be young; it is best to use them just as soon as they are large enough to receive the bud. When inserted in old stocks the buds do not sprout readily. The method of budding is the same as that described for the Avocado and Mango.

A simple method of propagation which may be employed when it is desired to obtain a limited number of plants from a bush producing fruits of particularly choice quality, is as follows: With a sharp spade cut into the soil two or three feet from the tree, severing the roots which extend outward from the trunk. Sprouts will soon make their appearance. When they are of suitable size they may be transplanted to permanent positions. They will, of course, reproduce the parent variety as faithfully as a bud or graft.

The Guava is a heavy bearer and ripens its fruit during a long season. In some regions guavas are obtainable throughout the year, though not always in large quantities. Seedlings come into bearing at three or four years of age; budded plants may bear fruit the second year after they are planted in the orchard. The season of ripening in Florida and the West Indies is in late summer and autumn.

The Guava is subject to the attacks of numerous insect and fungous enemies. All of these can be held in check by the usual means, i. e., spray-

ing with kerosene emulsion or some other insecticide or fungicide, but little attention is given to this matter in most tropical countries.

CERIMAN (*Monstera Deliciosa*)

This is one of the greatest curiosities of the tropics. The stalk climbs a tree, wall or fence, sending down roots to the ground; and the huge leathery leaves, shaped like a calladium (or elephant's ear) are full of irregular holes and indentations which give it a grotesque appearance.

The blossom resembles a white calla lily and is very fragrant.

The fruit, which takes fourteen months to mature, is shaped much like a policeman's club and the outer rind is cut in hexagons. When it ripens these scale off, beginning at the base, and the air about the tree is filled with the fragrance of ripe bananas.

The pulp is described as being the consistency of the pineapple with the added flavors of banana and strawberry.

It is a splendid shipper. It does best in a shady location, and it may be allowed to climb up the outer wall of a house.

VANILLA

A vine of the orchid type, which climbs trees, fences or sides of buildings, clinging and sending roots to the ground at the joint of every leaf.

A native variety closely resembling the commercial sort is found in the hammocks of South Florida.

It is grown commercially in the lowlands of Mexico and Central America, where a peculiar insect exists that pollinizes the blossom in its search for honey.

In Florida there is no such insect at present, but its function is easily performed by hand and the plant produces abundance of typical pods when thus treated.

After the pods have reached maturity, further treatment is required to bring out the full quality of vanilla flavor. This has been done successfully at Palm Beach by Mr. J. B. Donnelly.

These pods are often sold for \$17.00 per pound. For financial gain this offers unusual opportunities.

LITCHII (Chinese) Litchii Fruit

Native to China. A tree of medium growth with dense, very handsome foliage. This fruit is one of the principal standbys in southern China, a very long lived tree and very productive. The dried fruit is very often found in our seaports, especially where Chinese are numerous where it is sold as "litchee nuts." The fruit hangs in clusters, having a thin, roughened, tough skin-like rind, of a brilliant red color when ripe, and the translucent white flesh is firm and jelly-like in consistency and of exquisite refreshing flavor. This promises to be one of the most prominent fruit crops of the state, both because of its popularity with those to whom the fruit is familiar and also because the tree is hardier than the Mango—about like the Lemon. Prefers a moist, acid soil.

